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A linear worldview, according to which the economy is an inherently stable system, still seems to dominate the minds of many economists. Such a view of the economy dates back to the thirties, when Frisch, Slutsky and Tinbergen convincingly showed that linear dynamic models buffeted with noise generated time series patterns very similar to observed business cycle fluctuations. This linear view was challenged in the forties and fifties by the non-linear business cycle models of Goodwin, Hicks and Kaldor. The limit cycles generated by these models were much too regular, however, to explain the occasionally highly irregular movements in economic and financial time series data. Another important problem in these early non-linear business cycle models was that agents were in fact irrational, since their expectations were systematically wrong along the regular business cycles.

These shortcomings stimulated the rational expectations revolution – where agents are assumed to be perfectly rational, and expectations, on average, coincide with realisations. A representative, perfectly rational agent fits nicely into a linear view of a globally stable economy.

In mathematics and physics, things changed dramatically in the sixties and the seventies due to the discovery of deterministic chaos. The MIT meteorologist Edward Lorenz discovered that a simple non-linear system of three differential equations could generate highly irregular and seemingly unpredictable time series patterns. Even in a simple world described by just a couple of non-linear equations, (long-run) prediction becomes very difficult. In the early seventies, Ruelle and Takens developed a mathematical proof that a simple non-linear system of three or four differential equations, without any external random disturbances, can indeed exhibit complicated long-run dynamic behaviour on a strange attractor. Economists became much inspired by another mathematical article “Period three implies chaos,” by Li and Yorke in 1975, showing that many non-linear difference equations in one single variable exhibit chaos. For example, Benhabib and Day (1982) and Grandmont (1985) built simple non-linear business cycle models within the paradigm of rational expectations and competitive markets, generating chaotic business cycles.
An early signature of chaos

The roots of the “chaos revolution” in the sixties and seventies, however, could be traced back to the end of the nineteenth century in the work of famous French mathematician Henri Poincaré. In 1887, King Oscar II of Sweden promised to award a prize for the best essay concerning the question “Is our solar system stable?” In his prize-winning essay, Poincaré showed that the motion in a simple three-body system, consisting of sun, earth and moon, need not be periodic, but may become highly irregular and unpredictable – chaotic, in modern terminology. Poincaré introduced the notion of homoclinic orbit, an intersection point between the stable and the unstable manifold of an equilibrium steady state. Poincaré’s notion of homoclinic orbits turned out to be a key feature of complicated motion and strange attractors, and may be seen as an early signature of chaos.

Evolutionary dynamics

But what does all this have to do with economics? In a recent article (Brock and Hommes, 1997), a heterogeneous agent “cobweb” hog-cycle model with rational versus naive producers was studied. Agents could either buy rational expectations forecasts at positive information costs, or freely obtain a simple, naive forecasting rule. Fractions of the two types change over time according to an evolutionary fitness measure. Agents are boundedly rational in the sense that most agents will follow the strategy that has performed well in the recent past. This simple evolutionary economic system exhibits complicated price fluctuations when the trader’s intensity of choice to switch strategies is high. When the economy is close to its steady state, naive forecasts perform fairly well, and most agents will therefore use the cheap naive forecast. This will drive prices away from the steady state and destabilise the economy. But when prices diverge from the steady state, forecasting errors from naive expectations will increase; at some point it will become more profitable to switch and to buy the rational forecast. The economy will stabilise, and prices will move back closer to the steady state (and the story repeats). This simple evolutionary economic interaction between a “close to the steady state destabilising force,” and a “far from the steady state stabilising force,” is closely related to Poincaré’s classical notion of a homoclinic orbit; as such, it may be seen as a signature of potential instability and chaos in an evolutionary system with boundedly rational agents.

Financial markets as complex adaptive systems

In another recent article (Brock and Hommes, 1998), the evolutionary set-up was applied to a standard asset-pricing model. Agents can invest in either a risk-free asset, such as a bond, which pays a fixed return each period, or in a risky asset, such as a stock, which pays an uncertain dividend. In their investment decision, agents use different forecasting strategies to predict future prices and dividends. For example, fundamentalists use forecasts based upon market fundamentals such as dividends and interest rates. In contrast, technical traders look for patterns in past prices and use simple trend-following forecasting rules. Again, the evolutionary dynamics exhibits rational routes to randomness, that is, bifurcation routes to complicated asset price movements as the intensity of choice to switch forecasting strategies increases.
Figure 1 illustrates the fractal structure of one of the strange attractors in the asset-pricing model with evolutionary learning in Brock and Hommes (1998). The origin represents the fundamental steady state price. Asset prices deviate from their fundamental price, jumping irregularly over the strange attractor. The right panel illustrates the complicated geometric, fractal structure of the strange attractor around the unstable fundamental steady state.

The philosophy underlying our evolutionary approach is to use simple forecasting rules and “let evolution decide who is right.”

The philosophy underlying our evolutionary approach is to use simple forecasting rules and “let evolution decide who is right.” Forecasting rules that perform poorly will, at times, be driven out of the market, but may enter again in periods where they perform well. Such an adaptive equilibrium fits into what Sargent calls an equilibrium theory of misspecification. Realised market prices and expectations about these prices co-evolve over time. Sometimes this may lead to a fairly stable outcome, with prices moving towards the fundamental steady state of the economy. At other times, trend-following may lead to an unstable outcome – possibly with chaotic asset-price fluctuations.

Stylised facts
How realistic are the asset-price fluctuations in our simple adaptive systems? Important stylised facts observed in many real financial time series include unpredictable returns, clustered volatility and long memory. Figure 2 illustrates these stylised facts for 40 years of daily S&P 500 returns. The S&P 500 returns plot clearly shows that large (small) price changes tend to be followed by large (small) price changes. The small magnitudes of the sample autocorrelations of returns show that, from a linear viewpoint, the S&P 500 returns are unpredictable. In contrast, the sample autocorrelations of squared returns and absolute returns indicate that there are only a few ways one can be right.

Rationality versus bounded rationality
A good feature of rationality is that “there are only a few ways one can be right.” The rational expectations approach thus puts a natural discipline on agents’ forecasting rules and minimises the number of free parameters. In contrast, under bounded rationality, “there are many ways one can be wrong,” and it is not clear at all how to model deviations from rationality.

Although our evolutionary model is extremely simple, the simulated returns series resembles 40 years of S&P 500 data.
are highly significant and slowly decaying up to 50 lags, illustrating clustered volatility and long memory. The right-hand panel in figure 2 illustrates the stylised facts for a simple version of our evolutionary asset-pricing model, with only two types of traders, fundamentalists and technical analysts. The simulated time series exhibits unpredictable returns (almost no significant autocorrelations in returns) and clustered volatility and long memory (with slowly decaying autocorrelations of squared returns and absolute returns). Although our evolutionary model is extremely simple, the simulated returns series resembles 40 years of S&P 500 data.

**Figure 2: Comparing the stylised facts of daily S&P 500 data, 08/17/1961 – 05/10/2000 (left panel) with simulated data (right panel) from the evolutionary model buffeted with dynamic noise in Gaunersdorfer and Hommes (2000). In the S&P 500 returns series, the October 1987 crash and the two days thereafter have been excluded. Both returns series exhibit unpredictable returns, clustered volatility and long memory. Sample autocorrelations of returns, absolute returns, and squared returns of the S&P 500 data and the simulated data are similar.**

**(Un-)predictability**

If our simple, low dimensional evolutionary models give an accurate description of observed asset-price fluctuations, does this result imply a certain "forecastability" of asset returns that could be exploited by smart traders? In other words, do our models represent a market that is (close to) efficient? We would like to stress here that the extremely simple non-linear dynamic models discussed here are not easy to predict because of their sensitivity to noise. In order to illustrate this point, figure 3 shows the forecasting performance of the nearest-neighbour forecasting method applied to the chaotic returns series corresponding to the strange attractor in figure 1, buffeted with an increasing level of dynamic noise. This chaotic returns series has no autocorrelations, and returns are therefore unpredictable from a linear viewpoint. The optimal linear predictor is therefore the mean, and the horizontal line at 1 in figure 3 indicates the corresponding forecasting errors. The nearest-neighbour forecasting method looks for past patterns in the data and predicts that the next return will be an average of nearby patterns. As can be seen from the lowest graph in figure 3, this method yields excellent predictions, with errors much smaller than those obtained through prediction by the mean, in the deterministic chaotic case. However, as the level of dynamic noise increases, the forecasting errors rapidly increase to 1, even at short forecasting horizons. Our simple non-linear evolutionary system thus captures an inherent unpredictability that is so typical for financial series.

**Future perspective**

Economics has witnessed important changes in the last decades, from linearity to non-linearity, from a theoretical representative agent approach to a computational, multi-agent approach, and from abstract perfect rationality to bounded rationality models of behavioural economics. Much work remains to be done. At CeNDEF, within the Tinbergen Institute, we hope to contribute to these developments in modern economic theory.
Figure 3: Forecasting errors for nearest-neighbour method applied to chaotic returns series as well as noisy chaotic returns series, for different noise levels. This plot was made by Sebastiano Manzan and is discussed in Hommes (2001). All returns series have close-to-zero autocorrelations at all lags. The horizontal line at the normalised prediction error 1 represents the benchmark case of prediction by the mean. Nearest-neighbour forecasting applied to the purely deterministic chaotic series leads to much smaller forecasting errors (lowest graph). A noise level of say 10% means that the ratio of the variance of the noise term and the variance of the deterministic price series is 1/10. As the noise level slowly increases, the graphs are shifted upwards. Small dynamic noise thus quickly deteriorates forecasting performance.

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Global challenges of capital markets integration

By Jean-Marie Viaene

A changing world

Although international capital movements have been prominent for quite some time, it was only during the 1980s that financial markets gradually began to progress towards a competitive global industry – followed thereafter by an unprecedented speed-up of this integration. Abetting this process were the liberalisation of capital account transactions, the trend toward increased private saving for retirement, the development of the European Community’s single market in financial services, and certain banking reforms in major advanced countries. Gross flows of portfolio and foreign direct investment more than tripled between the mid-80s and the mid-90s, resulting in cross-border transactions in bonds and equities that currently surpass the GDP values of most advanced countries. The increased mobility of capital coincided with the growing recognition that economies now revolve around the production and use of knowledge. With the continuous “upskilling” of jobs, investment in education has become a high priority in many developed and developing countries.

These realisations, which have led to a re-examination of the effects of long-term capital movements, have also raised some important questions: what are the dynamic benefits of capital markets integration (CMI) in terms of aggregate production and its allocation between countries? What are the effects of CMI on the distribution of incomes in capital-rich and capital-poor countries? Does the integration of a particular country’s economy into world capital markets affect the investment decisions taken by its government and individual households with regard to education? This review, which examines the record to date of the integration of various countries into the international financial system (Viaene and Zilcha, 2001a, 2001b), stems from a larger project on dynamic modelling of heterogeneous agents in integrated economies. The type of international capital movement under consideration here involves a change in the location, but not the ownership, of physical capital – a phenomenon that lies at the heart of the much-disputed globalisation of capital markets. When integration of capital markets takes place, physical
Capital literally flows from the low-return country to the high-return country until interest rates are equalised in the integrated economy.

**Endogenous growth and free capital flows**

The specific models we analyse integrate several features of the recent literature on endogenous growth. They provide an extremely efficient analytical tool for studying income distribution and growth in, as well as convergence between, various countries. A central issue in these endogenous growth models has been the evolution of human capital (see, e.g., Lucas, 1988; Azariadis and Drazen, 1990). The production function of human capital is a complex matter, since education and learning occur in various ways. It is not surprising that statistical offices of international organisations compile extensive lists of indicators that describe and compare educational achievements across countries (see, e.g., OECD, 1997). While these features vary from country to country (which implies that there may not be a single theory that characterises all the observed developments), two main common elements have characterised the processes of human capital formation. First, the production function for human capital exhibits the property that agents from below-average educational backgrounds have a greater return to human capital investment derived from public schooling than do those coming from above-average human capital families. Also, the efforts, and therefore the costs, of acquiring human capital for the younger generation will be smaller for societies that are already endowed with relatively higher levels of human capital (see, e.g., Tamura, 1991; Fischer and Serra, 1996). Second, parental tutoring plays an important role. For example, Glaeser (1994) divides the education’s positive effects on economic growth into parts, and concludes that children in families with educated parents seem to obtain a better education than do those children without that supportive context.

In such frameworks, integration of capital markets between economies does not necessarily increase the long-run rate of economic growth. In this regard, the finding contradicts a common belief in international economics. However, even in trade theory, the result that trade in goods affects the rate of growth is not robust (see, e.g., Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991). Generally, trade models with physical capital in R&D activities, or those with trade policies that increase the stock of knowledge, show changes in the rate of growth. This provides a temptation to modify our framework in order to generate growth effects of capital markets integration. However, in contrast to the visible returns to R&D activities, a large share of public spending on education finances the (less measurable) human capital involved in the process.

**How integration benefits participating countries**

Although the integration of capital markets is unable to affect the long-run growth rate, it does, when compared to autarky, affect economic development during the transition periods. Thus, total output of the integrated economy after CMI seems to be higher than under autarky at all dates. Likewise, aggregate capital stocks are also higher at all dates following integration. Hence, free and perfect capital mobility leads to overall dynamic gains for the integrated economies. Based on numerical simulations, gains in income on the order of 1.5 to 2 percent per period are observed in the short run, with gains fading away quickly thereafter.

Although these results are quite strong, their significance is somewhat limited by two considerations. Since aggregate incomes increase for all periods after integration, some transfer systems can achieve a Pareto-dominating allocation – with all individuals in integrated economies becoming better-off following capital market integration. This is not necessarily the case if the competitive mechanism acts alone. Second, there is an implementation paradox: first generations in all integrated countries gain in terms of utility, and will vote in favour of integration, even though some later generations lose.

**Division of the gains**

Although some capital flows are observed between wealthy and poor countries, the largest part of global direct investment is that among the developed countries themselves, rather than between these countries and the less developed. Direct investment is now dominated by Japan, the United States and the EC – all investing in each other. An intriguing question raised by Lucas (1990) is why more capital does not flow into poorer countries. One of our results is that...
A country’s share in total output, and share in the stock of physical capital of the integrated economy, is given by its share in the stock of human capital.

Each country’s share in total output, and share in the stock of physical capital of the integrated economy, is given by its share in the stock of human capital. Countries that are poor in human capital thus have a low share in total physical capital stocks, and therefore a low share in total output. This result simply follows from the international equalisation of returns to physical capital and from the properties of neo-classical production functions.

**Competition between governments**

A typical policy advocated by international organisations is that developing countries, in order to capture the benefits of integration into world capital markets, should attract long-term foreign investment by cultivating a “healthy” economic environment – a process that includes investment in human capital. Why? A country that increases its investment in education is raising its marginal return to physical capital, thus attracting a larger share in the limited global capital available for investments. Capital market integration therefore enhances competition among governments with regard to their education policy.

Various solutions to such competition in education have been considered. We show that the “optimal” public education is the same, regardless of whether governments agree on a co-operative solution or a Nash bargaining solution. In contrast, in the Nash equilibrium between any two governments, we obtain a non-Pareto optimal level.

**Implications for income distribution**

Income distribution is a key economic issue, and its importance is forcing economists and policy makers to sharpen their understanding of its underlying determinants. Evidence of a rise in income inequality has been observed in a large number of OECD countries. Some believe that social norms are crucial determinants of earnings inequality (e.g., Atkinson, 1999). Others maintain that this rise is driven by, instead of, events like progress in information technology and integration of world trade and financial markets. Earlier empirical analyses confirmed the popular belief that income inequality is harmful to economic growth (see, e.g., Persson and Tabellini, 1994). More recent empirical findings (Forbes, 2000) are inconclusive, however, which is confirmed in our work. Our models as they stand allow us to explore the impact on income distribution of various events – such as capital markets integration, or changes in initial conditions or in the relationships or in the strength of familial and societal externalities. To illustrate, international factor movements alter the relative domestic supplies of productive capital and, hence, are expected to change the intragenerational distributions of income. Income distributions actually have a tendency to change according to the flow of capital, resulting in a more equal income distribution in the capital-exporting country, and less equal income distribution in the receiving country at all dates. Although there is no firm effect on long-term growth rates, capital markets integration clearly impacts the income distributions of the participating countries.

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Development economics is a vast field, covering topics in microeconomics and macroeconomics. Do you have a preference for either one?

I’m interested in both, actually. One topic that is sort of in-between the two is trade shocks: the economic impact of violent changes of commodity prices on world markets. The macroeconomic side of that has to do with a shock’s balance of payments impact and its impact on government budgets and debt positions. Its microeconomic impact concerns saving behaviour. For a long time economists have argued that smallholder households (households of farmers with very small areas of land) would not respond to shocks in an economically rational way. A lot of my early research used survey data to see whether that is true or not. It is now clear that even poor, illiterate farmers will save in response to positive shocks. This has changed the attitude of governments towards taxation of agricultural products. This process is, I think, central in the field of development economics. You take a policy question on which you need economic evidence,
like: should the government isolate households from world shocks, or not? You then formulate a hypothesis based on microeconomic theory, and use survey data to test that theory econometrically.

What distinguishes development economics from economics in general?
Development economics applies the tools of modern economics to situations in which markets function imperfectly, or do not exist. For example, property rights may not have been established, or infrastructure may not function very well. This has implications for the functioning of economic agents. This may not be an issue in most advanced economies.

What are your current research interests?
I'm working on the functioning of African labour markets and on the effect of aid on domestic taxation. Concerning the latter, what donors would like to see is that their money is not used as a substitute for raising taxes domestically. They encourage governments to raise more taxes, partly as a condition for aid. There are good theoretical reasons why that might be a bad combination. The costs resulting from distortions you impose on the economy might be quite high in developing countries. I am investigating whether aid can actually be harmful by imposing these costs of taxation. It's a theoretical question, but one that's directly related to policy debates.

Much of your work has been on Africa. Why is Africa so special?
Poverty is very much an African problem, and increasingly so. A lot of the poverty in Latin America and East Asia has disappeared. There are still poor people there, but far less than a generation ago. South Asia has the largest number of poor people, but it appears to be rapidly moving out of poverty. Africa has the largest percentage of the population below any poverty line you can imagine. What I foresee is that poverty in South Asia will continue to decline, and that in Africa it will remain much more entrenched. Such a grim prospect is motivation enough for trying to understand the nature of the problems there.

Does economic research explain why people are poor?
I think so. We can't provide complete answers, but we can clarify what the main determinants of poverty are, so that we are at least not barking up the wrong tree. I think that is a modest position. We're not going to change the world, but we might be one of the helping hands.

How?
Well, publishing an article is not going to end poverty in Burkina Faso, but it might influence thinking, and eventually lead to policies that do change poverty in Burkina Faso. Like Keynes, I believe in the power of ideas. As academics, we are often too cynical about the effects of our own work. I think that's wrong; ideas can often be traced to academic work, and can influence policymakers both in developing countries and in donor agencies. That's why economic research is so important.

Can you give an example of research leading to changes in policy – for the better, that is?
Well, consider the case of trade shocks: the dominant policy adopted by almost all developing countries, and with the blessing of the World Bank, was to insulate producers from shocks by stabilising export taxes for commodities like coffee, tea, and tobacco. That policy has now been abandoned almost everywhere, and the World Bank has explicitly referred to the microeconomic evidence in support of changing the policy. I'm not claiming that because of my research, and that of colleagues, we have changed poverty in Uganda, but I am saying that our research has certainly contributed to the policy change. Some of the rapid poverty reductions we see in Uganda have been caused by farmers getting better prices – as a result of the change in policy.

Which developments within development economics research do you see occurring?
I see the focus on microeconomics and applied econometrics getting stronger. There's also an increasing awareness that we need formal policy analysis. The textbook argument that the removal of a single distortion is welfare increasing is not very helpful when there are many distortions: second-best problems are important in development economics. Take the issue of sequencing, for example. We've come to realise that you have to think very carefully about the order in which you take liberalisation measures. The World Bank and the IMF are now really focusing on those issues. If you want to do that well, you need a model of the economy. Sometimes it is simple – you can do it on the back of an envelope – but often it's not.
Some of the rapid poverty reductions we see in Uganda have been caused by farmers getting better prices – as a result of the change in policy.

Regarding Africa, there has been an enormous debate on whether structural adjustment was good for poverty elimination or not. That debate has been partly resolved by using general equilibrium models as a sort of laboratory in which you test the effect on various groups in the society. I envision simulation exercises using general equilibrium models as becoming more important.

What is the way out of poverty for Africa?
Typically, poverty goes down in the presence of economic growth. Another way of asking the question is: why isn’t there more growth? This is where microeconomic research plays a role – by telling you something about the environment and behaviour of firms. Part of the answer is that, in many African countries, the state has been very active in doing the wrong sort of things, like trying to take over the manufacturing sector. It has very often neglected its more traditional roles, notably the provision of infrastructure and a viable legal system. These are really important, because high transport costs or inefficient ways of settling claims between people can stop investments from taking place. Why the state has not provided the necessary infrastructure and legal system is a question of political economy. Particular groups that do not want the state to have a good legal system, or build high quality roads in rural areas, but want to use the state for their own interests instead may have captured the state.

A related issue is the enormous risk present in many African economies. Some of the risk cannot be controlled, like the risk of the weather, or volatility of world prices. However, policy risk also plays a role. The government may make certain policy statements, for example, but has insufficient credibility for investors to believe them.

Consider the uncertainty surrounding future economic policies, taxation, international trade, and price controls. If you look at interviews of investors, both domestic and foreign, you see that such abnormal risk can simply put a halt to investment. Here, I think, the traditional macroeconomist who emphasises the importance of stability is right. It is important to have a stable regime that is also perceived as being stable. We are beginning to get that in a few African countries, but it is still a very small number.

What should rich countries do, in your opinion, with respect to their policies towards developing countries?
A lot of the debate has focused on aid flows. That debate has changed enormously in the last five years. It has become clear that rich countries have allocated aid over coun-
tries in a very inefficient way. This makes it hardly surprising that a lot of people say that “aid does not work”. It is to some extent true, but is largely the result of giving money to governments that are unlikely to do something sensible with it. Some of the rich countries are therefore changing their aid policies. Probably more important, though, is the opening of markets. There still is a lot of protection in rich countries. Agriculture and clothing and textiles are good examples. We have said, for more than a generation, that 

In Africa, the challenge is sustained growth – particularly for the larger economies.

these exports are vital to developing countries and that we will open our markets. Yet, we keep postponing the opening, which hinders development in these countries.

Are you optimistic about the future of Africa?

If all of our impressions of Africa come from television, which emphasises the famines and war that take place, we miss an important point. Some countries have made a lot of progress, which gets very little publicity. A small economy like Botswana has been the top country in terms of economic growth for a long time now. Uganda is doing very well, and quite a few other countries have hit 6-7 percent growth rates. Sustained growth is the challenge – particularly for the larger economies, because at the moment the more successful countries are typically the smaller economies. What would really “make headlines” is a country the size of Nigeria taking off – but that’s not happening yet. So, to answer your question: I am optimistic, but only mildly so.

References


Managing exchange rate risk

Until the time that the world is united, or at least using one common currency, firms that operate in international waters will continue to run the risk that the value of their foreign investments will change due to fluctuations in the exchange rate. These fluctuations can be large: The US dollar, for example, which appreciated 7.5% compared to the German D-Mark in 1998, appreciated about twice as much during the year 1999.

Firms can decide to hedge their currency risk. Instead of accepting the uncertain variation in the exchange rate, the firm pays the difference between the foreign and the national risk-free interest rates. This paper develops a framework to assist the manager, on a daily basis, in deciding whether or not to hedge. The decision is based on optimizing a utility function as a function of the hedge ratio, using the predictive distribution of tomorrow’s exchange rate return as input. For a range of seven models, we construct this predictive distribution using Bayesian methodology. In
In this way, we can incorporate parameter uncertainty and filter out the little information the data contains about a local trend in the exchange rate, thus also obtaining a prediction of the uncertainty of tomorrow’s return. During the evaluation period 1998-1999, one of the seven models – with varying variance (stochastic volatility) and an unobserved local trend – fits the data best. The model is good at guiding the risk manager in taking the decision to hedge currency risk in periods of high risk of depreciation, while also helping him to avoid missing out on the possible profits during periods of a rising exchange rate.

Charles S. Bos, Ronald J. Mahieu, Herman K. van Dijk (EUR), “Daily Exchange Rate Behaviour and Hedging of Currency Risk” TI 01-017/4

Trade-offs in employment relations

In the fast-food industry, two different types of labour relations exist side-by-side: a fixed-wage employment contract with perfect insurance, and a franchising arrangement, whereby the worker is the owner who takes all the risk. How do we explain the co-existence of two such widely different organisational principles? This paper explores the role of the non-verifiability of output. With non-verifiable output, firms can only insure workers when they are entitled to all of the worker’s output. If not, workers would only sell their output to the firm in bad states of nature. In good states of nature, workers would sell the output on the market. An employment relation with production taking place within the firm guarantees that workers deliver their output to the firm, in both good and bad states of nature. However, by organising production in a firm-specific employment relation, new contracting problems arise, which have been previously analysed by Macleod and Malcomson (1989). Firms can claim that workers have not provided effort, and therefore refuse to pay their wages. Since output is non-verifiable in a court of law, the wage payment by the firm must be self-enforcing. A trade-off therefore exists between the gains from insuring risk-averse workers and the transaction cost of a self-enforcing contract. We show that competition from the market may lead to excessive flexibility and to the crowding-out of welfare-improving fixed-wage employment relations.

A. Lans Bovenberg (KUB), and Coen N. Teulings (EUR), “Insurance and Information: Firms as a Commitment Device” TI 01-020/3

Modelling investment strategies

This paper presents a general dichotomous model for analysing and pricing investment strategies. Unifying modern portfolio theory and option pricing theory, it shows that inherent efficiency (or the absence of approximate arbitrage) implies a unique price for any investment strategy — expressed as the sum of two separate values: its up-market discounted value and its down-market discounted value. Since financial assets are essentially special buy-and-hold strategies, the model encompasses virtually all known European-type derivative-pricing models (see, e.g., Black and Scholes, 1973). More importantly, the model allows firms and individuals to evaluate rigorously those investment strategies for which the complete-market hypothesis does not hold — for example, where decisions involve real options.

Among the dichotomous model’s empirically testable predictions are a pair of linear equilibrium relationships between each security’s up-market (down-market) potential and the market’s inherent reward (inherent risk). These predictions are stronger than those of other equilibrium models (e.g., mean-variance), and are hence more verifiable. Other issues discussed in the paper include the non-negative wealth constraint, individual optimality with dichotomous utility functions, heterogeneous beliefs in market directions, quasi-complete markets, flat options, Pareto efficiency, and the existence of equilibrium. The theoretical foundation is laid in a preceding paper (Zou, TI 2000-50/2).


All discussion papers can be downloaded via www.tinbergen.nl
Linkages to social efficiency

V. Bala and Sanjeev Goyal (EUR)

Traditionally, economists have sought to explain social and economic phenomena using an approach based on individual optimisation, where the individuals are located in centralised settings and interact anonymously. Perhaps the most classic example of this approach is the analysis of the nature of equilibrium in competitive markets with a large number of players. Recently, researchers have begun to analyse the more general forms of interaction between individuals – the role of social structure, for example. This work has revealed, first of all, that non-market aspects of interaction are central to understanding a variety of phenomena. The research has also indicated some routes through which the influence of interaction may work. Yet the question remains: which forms of interaction are plausible?

Count the costs...

To address this question, we conceptualise interaction structures as networks – with individuals as nodes, and their relations as links. In many settings of interest, individuals themselves shape the nature of their interaction with others. We are thus able to postulate that social and economic networks are formed by individual decisions that trade-off the costs of forming and maintaining links against the potential rewards from doing so. In our study we suppose that one individual’s link with another allows access – in part and in due course – to the benefits available to the latter via his own links. Thus, individual links generate externalities for others. We suppose that the costs of links are borne by the players who initiate the links, and this assumption allows us to formulate the network formation game as a non-cooperative game.

Narrow down the options...

Our results indicate that strategic incentives to balance the costs and benefits of links sharply limit the nature of network architectures that can arise. We narrow down the possibilities for equilibrium networks (under fairly general conditions) to two configurations: they are either wheels (with a single cycle connecting all individuals) or stars. Interestingly, we find that if indirect links are as good as direct links, then the centre/hub of a star pays for all the links, while if indirect links are less valuable than direct links, then the spokes/peripheral players pay for the links as well. We then examine the dynamics of network formation, and find that individuals learn rapidly and that the dynamic process converges to the equilibrium networks identified earlier. Finally, we show that strategically stable networks in many of the settings we study are also socially efficient.


Emotions as a new source of efficiency costs?

Ronald Bosman and Frans van Winden (UvA)

Psychological research has shown that emotions are important for many psychological processes, like learning, attention, and memory. Recent neuroscientific research even suggests that emotions are important for rational decision making. Economists, however, have thus far neglected the role of emotions in their research. Our study investigates whether emotions are important for economic decision making. We start with a two-player power-to-take game that models in a simple but fundamental way situations in which one agent can (potentially) appropriate part of the endowment of another. This game captures important aspects of taxation, principal-agent relationships, and monopoly pricing. In the area of taxation, for example, an owner of a production factor could diminish the supply of this factor if he or she feels that the tax on the returns of this factor is outrageous.

In the experiment, players earn an income in an individual effort task preceding the power-to-take game. The game itself consists of two stages.

First, one player (the take-authority) can claim any part of the income of the other player (the responder). In the second stage, the latter player can respond, perhaps by destroying his own income. The transfer of money is based on what is left after the second stage. Responders can punish greedy take-authorities by destroying their own earned income. We focus on how emotions influence responder behaviour. The results show the following: (1) a higher take rate increases the intensity of negative emotions (such as irritation, contempt, and envy), and decreases the intensity of positive emotions (like happiness and contentment); (2) negative emotions drive destruction; (3) at moments of high emotional intensity, responders destroy either nothing or everything; (4) responder expectations regarding the response of the take-authority affect the probability of punishment. Because destruction of own earned income is inefficient (scarce resources are being destroyed), emotional hazard is identified as a new source of efficiency costs.

other publications

Banishing naïveté
Frank A.G. Den Butter (VU) and Mary S. Morgan (UvA)

The interaction between economic modellers and policymakers

The tenth anniversary of the Tinbergen Institute was celebrated with a research conference on a topic that was close to the heart of the Institute’s namesake? The conference focused on how economic models are used in the policy process and brought together prominent economists and policymakers from nine countries.

The naive view of economic models that aim to influence policy maintains that economists use models to produce advice, which may be either rejected or accepted by policymakers. Actually, a more sophisticated two-way interaction between modellers and policymakers has been widely recognised by those involved, but has hardly been discussed, let alone been the subject of academic research.

Economic models lie at the heart of any successful interaction between economic modellers and policymakers, enabling both parties to make use of their comparative knowledge. But the institutional context is equally important, for while many different kinds of models have dual purposes – providing knowledge as well as the opportunity of negotiation between the parties – they will miss the mark unless communication and trust exist between the two groups. Thus, different institutional contexts affect the interaction process. The range of experiences in various countries, from Norway to the Netherlands, from Canada to New Zealand, supports the conclusion that there is no single institutional formula for success.

What does it take? Fruitful interaction between policymakers and economists through economic models takes many forms. For example, the US Federal Reserve’s Open Market Committee operates with a formal presentation of modelling results followed by an informal and wide-ranging discussion of the results in which model assumptions are brought into question and requests for new model elements are made. J.J. Polak, one-time research assistant to Jan Tinbergen, and founder of the long-standing IMF model to assess its country programmes, maintains that the flexibility and size of his model have been critical to its usefulness in countries where local policymakers need to be persuaded to take unpopular measures. The small size and simple relations of the model make it easy to understand, thus providing the basis for explaining policies to non-economists; the model also makes minimal demands regarding data, rendering it appropriate for many underdeveloped economies.

Behind the scenes humour

The individual case studies found in the report make ideal teaching material, and summary material can be found in the two concluding chapters. Of particular interest is the transcript of the stimulating panel discussion in which three eminent economists, encouraged by Ruud Lubbers (former Dutch prime minister and currently UN High Commissioner for the Refugees), recall tense and humorous moments during policy arguments. For example, Lisa Lynch describes how differences between economic model predictions played a critical role in first creating and then resolving the famous budgetary problems that led to the Federal Government shutdown in the US in 1995/6. Edmond Malinvaud looks back on how politicians thought they could do better than economists in solving the problem of stagflation in the early 1970s, while Henk Don ponders the question of how to educate political interests so that they won’t worry about the second decimal place of a model forecast!


Dealing with exchange rate models

According to the asset market view on foreign exchange markets, exchange rates can be seen as the present value of expected future values of macroeconomic variables, such as money supplies and real incomes. Under a floating exchange rate regime, this asset market view implies that new information regarding future money supplies and real incomes, however small, can induce large exchange rate fluctuations. This, in combination with phenomena such as sticky goods prices, results in sizeable and long-lasting deviations between floating exchange rates and the aforementioned macroeconomic variables.

As data on floating exchange rates are available only from 1973 onwards, our difficulty in empirically corroborating the asset market view on exchange rates is hardly surprising, given the above-mentioned long-lasting deviations. To circumvent this, we combine the data on exchange rates and monetary fundamentals for a large number of industrialised countries into a panel data set.

For example, we test the empirical validity of the monetary exchange rate model on a sample of bilateral exchange rates and monetary fundamentals of 14 OECD countries, relative to both the US dollar and the German Mark. The test results for each of the bilateral exchange rates separately provided no evidence supporting this monetary...
model. However, after combining the time series for the 14 above-mentioned bilateral exchange rates into a panel data set, we found ample evidence in favour of the monetary exchange rate model—irrespective of the choice of base country.

Thesis: "Testing multi-country exchange rate models"
By Jan J.J. Groen.
Published in the Tinbergen Institute Research Series #230.

Exploring the utilisation of long-term care in the Netherlands

Long-term care services, a major component of the Dutch healthcare system, currently account for 23% of total Dutch healthcare expenditures, and amounts to 7 billion dollars per year. As the expected growth of the elderly population will certainly increase the demand for long-term care provision, available resources will obviously be stretched. Available evidence suggests that the Dutch long-term care system is currently supply-constrained. Recent national publications have reported that approximately 29,000 Dutch elderly individuals are currently waiting for home care, and 15,000 for placement in a care facility. Given this back-

log, we must question the sustainability of the existing long-term care system. Sensible reforms require insights into how the elderly actually use the long-term care services that are available. The primary aim of this work is to provide a better understanding of this process by providing a solid economic framework and testing it econometrically. The process by which long-term care services are accessed in the Netherlands is highly complex and can be studied from many different angles. The dissertation focuses on four core elements of the process: characterisation of health status, calculation of age- and gender-specific life expectancies in specific health states, determinants of utilisation of long-term care services conditional on the recognition of a need for care, and finally, the process of allocation of care by state committees. Changes in health status obviously play a central role in the evolution of the demand for care services. The paper derives a typology of the health status of elderly persons, which includes six dimensions: respiratory diseases and/or cancer, other chronic diseases (these diseases are generally less serious and not specific to the elderly), cognitive impairment, serious arthritis, cardiovascular diseases, and no health problems.

Policymakers using this health typology would find it easier to determine where the costs are highest. This kind of information will become increasingly important as the population ages.

Thesis: Long-term care services for the Dutch elderly; An investigation into the process of utilization.
By France Portrait.
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