Schnytzer, Adi; Lamers, Martien; Makropoulou, Vasiliki

Working Paper
The impact of insider trading on forecasting in a bookmakers' horse betting market

Working Paper, No. 2011-14

Provided in Cooperation with:
Department of Economics, Bar-Ilan University

Suggested Citation: Schnytzer, Adi; Lamers, Martien; Makropoulou, Vasiliki (2009) : The impact of insider trading on forecasting in a bookmakers' horse betting market, Working Paper, No. 2011-14, Bar-Ilan University, Department of Economics, Ramat-Gan

This Version is available at:
http://hdl.handle.net/10419/96062

Terms of use:
Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.
The Impact of Insider Trading on Forecasting in a Bookmakers' Horse Betting Market

by

Adi Schnytzer¹, Martien Lamers² and Vasiliki Makropoulou³

¹Department of Economics, Bar-Ilan University
²Department of Financial Economics, Ghent University
³Utrecht School of Economics, Utrecht University

Email: schnyta@mail.biu.ac.il
       martien.lamers@ugent.be
       vmakropo@aueb.gr

Abstract.

This paper uses a new variable based on estimates of insider trading to forecast the outcome of horse races. We base our analysis on Schnytzer, Lamers and Makropoulou (2008) who showed that inside trading in the 1997-1998 Australian racetrack betting market represents somewhere between 20 and 30 percent of all trading in this market. They show that the presence of insiders leads opening prices to deviate from true winning probabilities. Under these circumstances, forecasting of race outcomes should take into account an estimate of the extent of insider trading per horse. We show that the added value of this new variable for profitable betting is sufficient to reduce the losses when only prices are taken into account. Since the only variables taken into account in either Schnytzer, Lamers and Makropoulou (2008) or this paper are price data, this is tantamount to a demonstration that the market is, in practice, weak-form efficient.

(The International Journal of Forecasting, Volume 26, no. 3, 2009, 537-542.)

Thursday, 17 September 2009
1. Introduction

Successful forecasting of horse race outcomes requires that the forecaster has a clear understanding of the variables at his disposal. The most common, and arguably important, variables in a horse betting market are the odds of the horses in a race. In the case where bookmakers operate in such a market, it seems reasonable to suppose that the fixed odds they provide would be reasonably unbiased estimators of the horses' winning probabilities. And yet, there is a considerable literature which suggests that this is not so (see, for example, Shin 1991, 1992 and 1993 and Schnytzer and Shilony 2003). What makes bookmakers' odds deviate from winning probabilities is agreed to be the extent of insider trading in the market, even though different authors characterize the mechanism underlying the concomitant distortion and its extent differently.

Accordingly, forecasting of race outcomes should take into account an estimate of the extent of insider trading per horse and of how this extent of insider trading in a bookmakers' horse betting market may be measured. Schnytzer, Lamers and Makropoulou (2008) [hereafter SLM] have developed a model for measuring the extent of insider trading in horse betting markets with bookmakers.\(^1\) Their paper develops a theoretical framework that examines the optimal price setting by bookmakers in the racetrack betting market and then uses it to measure the extent of insider trading in the market. Bookmakers are faced with the risk that insiders will account for information arriving after the opening odds (which may be assumed to contain most public information) have been set and will thus exploit any mis-pricing by the bookmaker by betting on horses whose price presents an expected profit for the insider. The model is an extension of the model developed by Makropoulou and Markellos (2007) and applied to the European soccer betting market. The basic intuition underlying the model is that fixed odds\(^2\) offered by bookmakers at the track are examples of call options and that, while bookmakers hope to offer only net of premium out-of-the-money options, when they err by underestimating a particular horse's true winning probability, they are liable to offer a

---

\(^1\) Theirs is not the first such method. Shin (1993) developed a method using a very different model.

\(^2\) For the purposes of this paper, by odds, we mean that odds of, say 5 to 1 represent a net profit of $5 for every $1 bet on the winning horse.
net in-the-money option, which the insider (who is assumed to know her horse’s true winning probability) will be glad to snap up.

Throughout this paper, we use the working assumption that the insider knows her horse’s true winning probability and this requires some elaboration. Indeed, it is difficult to come up with a precise definition of an inside trade for which data may ever be available. Thus, in reality, an insider is one who is more familiar with her horse than others and who therefore has an informational edge over outsiders and, *ceteris paribus*, is in a better position to evaluate the horse’s winning probability. But *ceteris* is not *paribus*! There are over- and under-optimistic insiders just as there are different kinds of outsiders. Some people know more about forecasting and some less. And these kinds of differences are never measurable in the kinds of data sets that are available from horse betting markets. Accordingly, we assume what we do about insiders and, with respect to outsiders, we assume that they bet according to the opening odds set by bookmakers, these being the best estimate available of public information prior to the start of betting at the track.

The way in which insiders bet involves the so-called plunge. This is a case where several gents of the insider approach different bookmakers simultaneously and back the same horse at the best odds available. The reason that a single bettor is usually insufficient is that bookmakers are permitted to refuse bets which would leave them with large contingent debts. Accordingly, an insider wishing to place really large sums of money on a particular horse will need to spread the bet across bookmakers. It should be noted that on-course bookmakers are small, independent firms who compete in selling a homogeneous product. Accordingly, competition among them is fierce and the trend in prices during the betting is always downwards unless a horse is plunged. However, since all bookmakers need to determine initial odds and since all in Australia must be members of the relevant state bookmakers’ Association, they save on research costs by obtaining a set of opening odds from the Association. These are not obligatory, but they tend to be

---

3 The precise size of the maximum bet which a bookmaker must accept varies from place to place but is rarely above a thousand dollars.
4 For the purposes of this paper, prices are defined in their economic sense as the amount that must be bet on a horse to ensure a total payback (including the initial outlay) of $1. Odds, on the other hand, have their traditional meaning; i.e. If the odds of a winning horse are X to 1, then $1 bet on the winning horse yields a total payback (including the dollar outlay) of X+1.
widely used. The important thing about these prices is they contain a high built-in expected mark-up which serves as a cushion of sorts against insiders. Of course, once a plunge arrives, every bookmaker is on his/her own and the prices of all horses in the race fluctuate freely. For our purposes, any fall in odds (increase in price) is taken as evidence of a plunge and we use this variable as a predictor for the outcome of the race.

We proceed as follows: In Section 2, the data are described and a brief discussion of our forecasting method is provided. The results are presented in Section 3, where it is shown that forecasting on the basis of opening prices only – these prices are readily available around 30 minutes before the race – yields moderate losses. The extent of these losses is reduced when the variable that measures insider trading is added, but the method employed here would be difficult, if not impossible, to implement in practice. Some conclusions are offered in section 4.

2. Data and Methodology

The data set used in this paper contains 45296 horses who ran in 4017 races during the 1997-1998 Australian horse racing season. The data include opening prices (hereafter OP) as set by bookmakers at the start of betting around 30 minutes before each race, middle prices (hereafter MP), which are prices provided in the data set usually, but not always, when there is a change in direction of the horses' odds between OP and odds at the end of the betting. Finally, we have starting prices (SP), the ruling prices at the end of betting. The data set contains all races for which MP are provided. The data were obtained from the CD version of the "Australasian Racing Encyclopedia '98".

SLM estimated several alternative measures of the extent of insider trading in this market and we use three of the estimates for the purposes of forecasting. However, in order to facilitate an understanding of these measures and the differences between them, a summary of the SLM estimation procedure is in order. Bookmakers' odds as initially set (i.e. OP), may be viewed as call options which end in-the-money if the horse wins the race and out-of-the-money otherwise. As inside information enters the market, the odds change and the value of the call options change. As betting continues, the horses' winning probabilities as implied by the odds become more and more accurate until all inside information has entered the market and the betting comes to an end. Assuming that the
inside information enters the market randomly from the point of view of the bookmakers, the dynamics underlying the changing implied winning probabilities may be modeled as a standard Wiener Process.

Using Monte Carlo simulation we are able to derive the option value for each horse. The true winning probability for each horse is simulated in 1000 time steps using a standard Wiener Process. When the simulated probability is larger than the strike price at the 1000th and final step, the option value is this positive difference; otherwise, the option value is zero. For each horse, the option value is calculated as the average value out of 1000 repetitions. In order to calculate the extent of insider trading, a weighting is applied to the option values. The following three different weightings used provide us with our estimates of insider trading for use in this paper.

The first weight used for each horse is the estimated initial winning probability as implied by OP, P(0). The remaining two additional weights are based on plunge behavior in the market and calculated as follows. The first is the relative size of a plunge, called PW: \( \max((MP-OP)/OP,0) + \max((SP-MP)/MP,0) \). The second weight is the absolute size of the plunge called PW2: \( \max(MP-OP,0) + \max(SP-MP,0) \). Using these weights, the weighted average degree of insider trading for each of the races in the sample is calculated. The simple average of these values is the extent of insider trading in the dataset.

Table I displays the extent of plunges in the data set, where an early plunge is defined as a positive percentage price change from OP to MP and a late plunge is defined as a positive percentage price change from MP to SP. A sustained plunge is defined in the case where the horse in question is subject to both early and late plunges; the extent of the sustained plunge is then the percentage change from OP to SP. It can be seen in Table I that the majority of the 13852 plunges in the dataset are late plunges, suggesting insider trading at MP. However, the average extent of early plunges exceeds that of late plunges.

Table I: The extent of plunges in the dataset

---

5 A horse is said to be plunged when its odds suddenly decrease meaningfully owing to large bets placed on the same horse with different bookmakers simultaneously. Schnytzer and Shilony (1995) show that plunges contain inside information.
<table>
<thead>
<tr>
<th>Plunges</th>
<th>Number</th>
<th>Average extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Plunge</td>
<td>1281</td>
<td>21.25%</td>
</tr>
<tr>
<td>Late Plunge</td>
<td>9783</td>
<td>15.72%</td>
</tr>
<tr>
<td>Sustained Plunge</td>
<td>2788</td>
<td>26.33%</td>
</tr>
<tr>
<td>All</td>
<td>13852</td>
<td>18.37%</td>
</tr>
</tbody>
</table>

Note: An early plunge is defined as a positive percentage change from OP to MP. A late plunge is defined as a positive percentage change from MP to SP. When there are both early and late plunges, this forms a sustained plunge.

The simple average of these values is a variable that measures the extent of insider trading as estimated by SLM, is shown in Table II.

### Table II: Measures of degree of insider trading for each specification

<table>
<thead>
<tr>
<th>Weight</th>
<th>Degree of insider trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>P(0) – OP</td>
<td>32.68%</td>
</tr>
<tr>
<td>PW</td>
<td>26.38%</td>
</tr>
<tr>
<td>PW2</td>
<td>26.48%</td>
</tr>
</tbody>
</table>

Notes: P(0) – OP is true winning probability at time 0. PW is the [\(\max((MP-OP)/OP,0) + \max((SP-MP)/MP,0)\]). PW2 is [\(\max(MP-OP,0) + \max(SP-MP,0)\)].

Armed with opening prices and various measures related to the extent of insider trading for each horse, we proceed to forecast the winners of each race in the data set. We use the generally preferred method of forecasting in the betting literature, namely; the conditional logit model (hereafter CL) of McFadden (1974). We estimate several CL models. The first estimates the probability of horse \(i\) winning race \(j\) based solely on information contained in OP, as follows:

\[
p_{ij}^o = \exp(a_i OP_{ij}) / \sum_{i=1}^{n_j} \exp(a_i OP_{ij})
\]

where \(i = 1, 2, \ldots, n_j\), \(OP_{ij}\) is the OP of horse \(i\) in race \(j\), \(n_j\) is the number of runners in race \(j\) and \(a_i\) indicates the contribution which OP makes to the horse’s chance of winning race \(j\). We then run four more regressions adding different predictors to OP in turn. These variables are as follows: First, the option value for each horse as estimated in SLM.
variable is zero for most horses in the sample and positive for one or two in each race. $Optionvalue_{ij}$ is positive if the horse $i$'s winning probability in race $j$ is estimated via Monte Carlo simulation to be greater than the winning probability implied by OP and is measured as the difference. In this case, the model estimated may be written:

$$p_{ij}^o = \exp(a_2OP_{ij} + b_1Optionvalue_{ij}) \sum_{i=1}^{n_j} (a_2OP_{ij} + b_1Optionvalue_{ij})$$

(2)

where $i = 1,2,\ldots n_j$. The coefficients $a_1$, $a_2$ and $b_1$ in regressions (1) and (2) are measured by maximizing the joint probability of observing the winners of all the races in the sample. Next we add $EarlyPlunge_{ij}$, which is equal to the difference between MP and OP, when this difference is positive and zero otherwise. Our fourth predictor is the extent of insider trading on horse $i$ in race $j$ as measured by SLM ($Insidertrading_{ij}$). Finally, we add $TotalPlunge_{ij}$, which measures the total extent of early and late plunges on horse $i$ in race $j$. We expect, a priori, that all variables would, by themselves, add to a horse's winning probability and should thus receive positive coefficients.

3. Results

Table III shows the results of our five regressions.

<table>
<thead>
<tr>
<th>Specification</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>Win</td>
<td>Win</td>
<td>Win</td>
<td>Win</td>
<td>Win</td>
</tr>
<tr>
<td>OP</td>
<td>6.7117 (50.58)*</td>
<td>6.6583 (47.09)*</td>
<td>6.5204 (45.73)*</td>
<td>6.4404 (44.91)*</td>
<td>6.3347 (43.88)*</td>
</tr>
<tr>
<td>Optionvalue</td>
<td>2.1108 (1.09)</td>
<td>1.5214 (0.78)</td>
<td>-2.7790 (-1.32)</td>
<td>-13.7064 (-5.63)*</td>
<td></td>
</tr>
<tr>
<td>EarlyPlunge</td>
<td>10.824 (6.79)*</td>
<td>10.1933 (6.39)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insidertrading</td>
<td>0.2741 (5.80)*</td>
<td>0.2079 (4.32)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TotalPlunge</td>
<td>9.3020 (9.62)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>45296</td>
<td>45296</td>
<td>45296</td>
<td>45296</td>
<td>45296</td>
</tr>
<tr>
<td>Pseudo – $R^2$</td>
<td>0.1389</td>
<td>0.1390</td>
<td>0.1412</td>
<td>0.1430</td>
<td>0.1456</td>
</tr>
</tbody>
</table>

---

6 The winning probabilities, when this and subsequent variables are added, may be estimated by models that follow trivially from (1) and (2) and thus are not noted explicitly.
Notes: Z-scores are reported in parentheses. A * indicates significance up to a 1% confidence level. Option value are the option values generated by SLM. Early Plunge is the extent of early plunges as measured by max(MP-OP,0). Insider trading is the incidence of insider trading on a specific horse, as generated by SLM. Total Plunge is the extent of both early and late plunges, as measured by max(MP-OP,0) + max(SP-MP,0).

It is clear on the basis of these results that OP is by far the most important predictor of winning probabilities, both in terms of coefficient size and statistical significance. Given the bookmakers' stake in the outcome of betting, it is clear that OP will reflect as much useful information as possible unless bookmakers deliberately distort prices as a defense mechanism against insiders.7 With the exception of option value, all other variables receive positive coefficients and these are statistically significant in at least one of the regressions. When option value is used as the sole predictor of winning probabilities, it receives a positive and highly significant coefficient8, leading us to conclude that the unexpected results here are the result of multicollinearity.

The following table shows the results of betting $1 on each predicted favorite in every race in the sample on the basis of the five regressions shown in Table III.

<table>
<thead>
<tr>
<th>Table IV: Betting Simulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betting based on favourite predicted by specification</td>
</tr>
<tr>
<td>Number of races and bets</td>
</tr>
<tr>
<td>Profit ($)</td>
</tr>
<tr>
<td>Rate of Return (%)</td>
</tr>
</tbody>
</table>

Notes: Betting takes place in all races as in each race there is a favorite as measured by the highest win probability predicted after each regression specification. Betting takes place at SP, the last quoted prices before the race starts.

The results obtained are in line with what the regression results in Table III might have led us to believe. Thus, insider trading seems to influence profits (in this case, losses) in an upward direction, although the tone is clearly set by OP, and betting on the

7 See SLM, Schnytzer and Shilony (2003) and Shin (1991 and 1992) for more discussion on this point.
8 Complete results available upon request.
basis of it alone leads to a loss of 10.2 percent. The best performance is achieved by adding option values, early plunges and the extent of insider trading to OP, but this only adds a little over 3 percent to the reduction in losses. However, since SLM rely exclusively on price data in their simulations, these results show that this market is, in practice, weak-form efficient. Further, even if the results are calculated as if betting takes place at the best odds available during the betting (as we would expect insiders to bet), rather than SP, returns are better but remain negative throughout.9 Finally, it may seem strange that the losses incurred in simulation 5, when all plunges are taken into account along with the other variables, should exceed those in simulation 4, when only early plunges are added to the model. The reason would appear to be the herding on late plunges in this market.10

4. Conclusions

In this paper we have shown that variables that measure insider trading, as measured by SLM, only have a moderate impact on the forecasting results. Adding various different measures relating to insider trading by horse to a conditional logit model using only opening prices to predict winning probabilities, reduces moderate losses but does not generate positive profits. Therefore, the relevance of insider trading in this market, in principle, cannot be refuted. However, it should be pointed out that even the small gains in forecasting demonstrated here may be difficult to implement in practice.

It is unlikely that the simulations used by SLM could be carried out in the short time required before each race. Thus, a knowledge of price changes is critical and if the latest prices used in the simulation were to be those ruling in the market five minutes or so before the race start, that would leave less than five minutes for the estimations. Since the simulations carried out by SLM required several days to run, a system based on our estimates could be applied only on a computer far more powerful than is generally available today outside the Pentagon! Furthermore, given the moderate gains generated by the addition of these variables to the basic model, it may be wondered whether it would be worthwhile to struggle for a solution to the computing problem.

9 Full results available upon request.
So why has the extent of inside information not contributed more dramatically to the forecasts? To the extent that the SLM model provides a reasonable measure of the extent of insider trading, it must be concluded that the reliance on price data alone in forecasting horse races in a bookmakers' market is doomed to failure. On the other hand, perhaps the basic weakness in regression models in forecasting is that they provide predictions on the basis of "on average" results, whereas insiders bet on particular horses in particular races when as many as possible relevant factors unbeknownst to outsiders have been taken into account.
5. References


Bar-Ilan University
Department of Economics
WORKING PAPERS

1-01 The Optimal Size for a Minority

2-01 An Application of a Switching Regimes Regression to the Study of Urban Structure

3-01 The Kuznets Curve and the Impact of Various Income Sources on the Link Between Inequality and Development

4-01 International Asset Allocation: A New Perspective

5-01 מודל הנושאים הכלכליים המשותפים

6-01 Multi-Generation Model of Immigrant Earnings: Theory and Application

7-01 Shattered Rails, Ruined Credit: Financial Fragility and Railroad Operations in the Great Depression

8-01 Cooperation and Competition in a Duopoly R&D Market

9-01 A Theory of Immigration Amnesties

10-01 Dynamic Asset Pricing With Non-Redundant Forwards

11-01 Macroeconomic and Labor Market Impact of Russian Immigration in Israel

Electronic versions of the papers are available at
http://www.biu.ac.il/soc/ec/wp/working_papers.html
12-01 Network Topology and the Efficiency of Equilibrium

13-01 General Equilibrium Pricing of Trading Strategy Risk

14-01 Social Conformity and Child Labor

15-01 Determinants of Railroad Capital Structure, 1830–1885

16-01 Political-Legal Institutions and the Railroad Financing Mix, 1885–1929

17-01 Macroeconomic Instability, Migration, and the Option Value of Education

18-01 Property Rights, Theft, and Efficiency: The Biblical Waiver of Fines in the Case of Confessed Theft
Eliakim Katz and Jacob Rosenberg, November 2001.

19-01 Ethnic Discrimination and the Migration of Skilled Labor
Frédéric Docquier and Hillel Rapoport, December 2001.

1-02 Can Vocational Education Improve the Wages of Minorities and Disadvantaged Groups? The Case of Israel
Shoshana Neuman and Adrian Ziderman, February 2002.

2-02 What Can the Price Gap between Branded and Private Label Products Tell Us about Markups?

3-02 Holiday Price Rigidity and Cost of Price Adjustment

4-02 Computation of Completely Mixed Equilibrium Payoffs
Igal Milchtaich, March 2002.

5-02 Coordination and Critical Mass in a Network Market – An Experimental Evaluation
6-02 Inviting Competition to Achieve Critical Mass
Amir Etziony and Avi Weiss, April 2002.

7-02 Credibility, Pre-Production and Inviting Competition in a Network Market
Amir Etziony and Avi Weiss, April 2002.

8-02 Brain Drain and LDCs’ Growth: Winners and Losers
Michel Beine, Frédéric Docquier, and Hillel Rapoport, April 2002.

9-02 Heterogeneity in Price Rigidity: Evidence from a Case Study Using Micro-Level Data

10-02 Price Flexibility in Channels of Distribution: Evidence from Scanner Data

11-02 Acquired Cooperation in Finite-Horizon Dynamic Games
Igal Milchtaich and Avi Weiss, April 2002.

12-02 Cointegration in Frequency Domain

13-02 Which Voting Rules Elicit Informative Voting?
Ruth Ben-Yashar and Igal Milchtaich, May 2002.

14-02 Fertility, Non-Altruism and Economic Growth: Industrialization in the Nineteenth Century
Elise S. Brezis, October 2002.

15-02 Changes in the Recruitment and Education of the Power Elites in Twentieth Century Western Democracies
Elise S. Brezis and François Crouzet, November 2002.

16-02 On the Typical Spectral Shape of an Economic Variable

17-02 International Evidence on Output Fluctuation and Shock Persistence

1-03 Topological Conditions for Uniqueness of Equilibrium in Networks
Igal Milchtaich, March 2003.

2-03 Is the Feldstein-Horioka Puzzle Really a Puzzle?
3-03  Growth and Convergence across the US: Evidence from County-Level Data  
Matthew Higgins, Daniel Levy, and Andrew Young, June 2003.

4-03  Economic Growth and Endogenous Intergenerational Altruism  
Hillel Rapoport and Jean-Pierre Vidal, June 2003.

5-03  Remittances and Inequality: A Dynamic Migration Model  
Frédéric Docquier and Hillel Rapoport, June 2003.

6-03  Sigma Convergence Versus Beta Convergence: Evidence from U.S. County-Level Data  

7-03  Managerial and Customer Costs of Price Adjustment: Direct Evidence from Industrial Markets  

8-03  First and Second Best Voting Rules in Committees  
Ruth Ben-Yashar and Igal Milchtaich, October 2003.

9-03  Shattering the Myth of Costless Price Changes: Emerging Perspectives on Dynamic Pricing  

1-04  Heterogeneity in Convergence Rates and Income Determination across U.S. States: Evidence from County-Level Data  

2-04  “The Real Thing:” Nominal Price Rigidity of the Nickel Coke, 1886-1959  

3-04  Network Effects and the Dynamics of Migration and Inequality: Theory and Evidence from Mexico  
David Mckenzie and Hillel Rapoport, March 2004.

4-04  Migration Selectivity and the Evolution of Spatial Inequality  

5-04  Many Types of Human Capital and Many Roles in U.S. Growth: Evidence from County-Level Educational Attainment Data  
6-04  **When Little Things Mean a Lot: On the Inefficiency of Item Pricing Laws**  

7-04  **Comparative Statics of Altruism and Spite**  
Igal Milchtaich, June 2004.

8-04  **Asymmetric Price Adjustment in the Small: An Implication of Rational Inattention**  

1-05  **Private Label Price Rigidity during Holiday Periods**  

2-05  **Asymmetric Wholesale Pricing: Theory and Evidence**  

3-05  **Beyond the Cost of Price Adjustment: Investments in Pricing Capital**  

4-05  **Explicit Evidence on an Implicit Contract**  
Andrew T. Young and Daniel Levy, June 2005.

5-05  **Popular Perceptions and Political Economy in the Contrived World of Harry Potter**  

6-05  **Growth and Convergence across the US: Evidence from County-Level Data (revised version)**  

1-06  **Sigma Convergence Versus Beta Convergence: Evidence from U.S. County-Level Data (revised version)**  
Andrew T. Young, Matthew J. Higgins, and Daniel Levy, June 2006.

2-06  **Price Rigidity and Flexibility: Recent Theoretical Developments**  

3-06  **The Anatomy of a Price Cut: Discovering Organizational Sources of the Costs of Price Adjustment**  
4-06  **Holiday Non-Price Rigidity and Cost of Adjustment**  
Georg Müller, Mark Bergen, Shantanu Dutta, and Daniel Levy.  
September 2006.

2008-01  **Weighted Congestion Games With Separable Preferences**  
Igal Milchtaich, October 2008.

2008-02  **Federal, State, and Local Governments: Evaluating their Separate Roles in US Growth**  

2008-03  **Political Profit and the Invention of Modern Currency**  
Dror Goldberg, December 2008.

2008-04  **Static Stability in Games**  
Igal Milchtaich, December 2008.

2008-05  **Comparative Statics of Altruism and Spite**  
Igal Milchtaich, December 2008.

2008-06  **Abortion and Human Capital Accumulation: A Contribution to the Understanding of the Gender Gap in Education**  

2008-07  **Involuntary Integration in Public Education, Fertility and Human Capital**  

2009-01  **Inter-Ethnic Redistribution and Human Capital Investments**  
Leonid V. Azarnert, January 2009.

2009-02  **Group Specific Public Goods, Orchestration of Interest Groups and Free Riding**  
Gil S. Epstein and Yosef Mealem, January 2009.

2009-03  **Holiday Price Rigidity and Cost of Price Adjustment**  

2009-04  **Legal Tender**  
Dror Goldberg, April 2009.

2009-05  **The Tax-Foundation Theory of Fiat Money**  
Dror Goldberg, April 2009.
2009-06  The Inventions and Diffusion of Hyperinflatable Currency  
Dror Goldberg, April 2009.

2009-07  The Rise and Fall of America’s First Bank  
Dror Goldberg, April 2009.

2009-08  Judicial Independence and the Validity of Controverted Elections  
Raphaël Franck, April 2009.

2009-09  A General Index of Inherent Risk  
Adi Schnytzer and Sara Westreich, April 2009.

2009-10  Measuring the Extent of Inside Trading in Horse Betting Markets  
Adi Schnytzer, Martien Lamers and Vasiliki Makropoulou, April 2009.

2009-11  The Impact of Insider Trading on Forecasting in a Bookmakers’ Horse Betting Market  
Adi Schnytzer, Martien Lamers and Vasiliki Makropoulou, April 2009.

2009-12  Foreign Aid, Fertility and Population Growth: Evidence from Africa  
Leonid V. Azarnert, April 2009.

2009-13  A Reevaluation of the Role of Family in Immigrants’ Labor Market Activity: Evidence from a Comparison of Single and Married Immigrants  

2009-14  The Efficient and Fair Approval of “Multiple-Cost–Single-Benefit” Projects Under Unilateral Information  
Nava Kahanaa, Yosef Mealem and Shmuel Nitzan, May 2009.

2009-15  Après nous le Délice: Fertility and the Intensity of Struggle against Immigration  
Leonid V. Azarnert, June 2009.

2009-16  Is Specialization Desirable in Committee Decision Making?  

2009-17  Framing-Based Choice: A Model of Decision-Making Under Risk  
Kobi Kriesler and Shmuel Nitzan, June 2009.

2009-18  Demystifying the ‘Metric Approach to Social Compromise with the Unanimity Criterion’  
Shmuel Nitzan, June 2009.
2009-19  On the Robustness of Brain Gain Estimates
Michel Beine, Frédéric Docquier and Hillel Rapoport, July 2009.

2009-20  Wage Mobility in Israel: The Effect of Sectoral Concentration
Ana Rute Cardoso, Shoshana Neuman and Adrian Ziderman, July 2009.

Shoshana Neuman and Adrian Ziderman, July 2009.

2009-22  National Aggregates and Individual Disaffiliation: An International Study

2009-23  The Big Carrot: High-Stakes Incentives Revisited

2009-24  The Why, When and How of Immigration Amnesties
Gil S. Epstein and Avi Weiss, September 2009.

2009-25  Documenting the Brain Drain of «la Crème de la Crème»: Three Case-Studies on International Migration at the Upper Tail of the Education Distribution
Frédéric Docquier and Hillel Rapoport, October 2009.

2009-26  Remittances and the Brain Drain Revisited: The Microdata Show That More Educated Migrants Remit More
Albert Bollard, David McKenzie, Melanie Morten and Hillel Rapoport, October 2009.

2009-27  Implementability of Correlated and Communication Equilibrium Outcomes in Incomplete Information Games
Igal Milchtaich, November 2009.

2010-01  The Ultimatum Game and Expected Utility Maximization – In View of Attachment Theory
Shaul Almakias and Avi Weiss, January 2010.

2010-02  A Model of Fault Allocation in Contract Law – Moving From Dividing Liability to Dividing Costs
Osnat Jacobi and Avi Weiss, January 2010.
2010-03  **Coordination and Critical Mass in a Network Market: An Experimental Investigation**  

2010-04  **Immigration, fertility and human capital: A model of economic decline of the West**  
Leonid V. Azarnert, April 2010.

2010-05  **Is Skilled Immigration Always Good for Growth in the Receiving Economy?**  
Leonid V. Azarnert, April 2010.

2010-06  **The Effect of Limited Search Ability on the Quality of Competitive Rent-Seeking Clubs**  

2010-07  **Condorcet vs. Borda in Light of a Dual Majoritarian Approach**  
Eyal Baharad and Shmuel Nitzan, April 2010.

2010-08  **Prize Sharing in Collective Contests**  
Shmuel Nitzan and Kaoru Ueda, April 2010.

2010-09  **Network Topology and Equilibrium Existence in Weighted Network Congestion Games**  
Igal Milchtaich, May 2010.

2010-10  **The Evolution of Secularization: Cultural Transmission, Religion and Fertility Theory, Simulations and Evidence**  

2010-11  **The Economics of Collective Brands**  

2010-12  **Interactions Between Local and Migrant Workers at the Workplace**  
Gil S. Epstein and Yosef Mealem, August 2010.

2010-13  **A Political Economy of the Immigrant Assimilation: Internal Dynamics**  
Gil S. Epstein and Ira N. Gang, August 2010.

2010-14  **Attitudes to Risk and Roulette**  
Adi Schnytzer and Sara Westreich, August 2010.
2010-15 **Life Satisfaction and Income Inequality**  
Paolo Verme, August 2010.

2010-16 **The Poverty Reduction Capacity of Private and Public Transfers in Transition**  
Paolo Verme, August 2010.

2010-17 **Migration and Culture**  
Gil S. Epstein and Ira N. Gang, August 2010.

2010-18 **Political Culture and Discrimination in Contests**  
Gil S. Epstein, Yosef Mealem and Shmuel Nitzan, October 2010.

2010-19 **Governing Interest Groups and Rent Dissipation**  
Gil S. Epstein and Yosef Mealem, November 2010.

2010-20 **Beyond Condorcet: Optimal Aggregation Rules Using Voting Records**  
Eyal Baharad, Jacob Goldberger, Moshe Koppel and Shmuel Nitzan, December 2010.

2010-21 **Price Points and Price Rigidity**  

2010-22 **Price Setting and Price Adjustment in Some European Union Countries: Introduction to the Special Issue**  

2011-01 **Business as Usual: A Consumer Search Theory of Sticky Prices and Asymmetric Price Adjustment**  
Luís Cabral and Arthur Fishman, January 2011.

2011-02 **Emigration and democracy**  
Frédéric Docquier, Elisabetta Lodigiani, Hillel Rapoport and Maurice Schiff, January 2011.

2011-03 **Shrinking Goods and Sticky Prices: Theory and Evidence**  
Avichai Snir and Daniel Levy, March 2011.

2011-04 **Search Costs and Risky Investment in Quality**  
To What Extent do Investors in a Financial Market Anchor Their Judgments? Evidence from the Hong Kong Horserace Betting Market

Johnnie E.V. Johnson, Shuang Liu and Adi Schnytzer, March 2011.

Attitudes to Risk and Roulette

Adi Schnytzer and Sara Westreich, March 2011.

False Consciousness in Financial Markets: Or is it in Ivory Towers?

Adi Schnytzer and Sara Westreich, March 2011.

Herding in Imperfect Betting Markets with Inside Traders

Adi Schnytzer and Avichai Snir, March 2011.

Painful Regret and Elation at the Track

Adi Schnytzer and Barbara Luppi, March 2011.

The Regression Tournament: A Novel Approach to Prediction Model Assessment

Adi Schnytzer and Janez Šušteršič, March 2011.

Shorting the Bear: A test of anecdotal evidence of insider trading in early stages of the sub-prime market crisis

Les Coleman and Adi Schnytzer, March 2011.

SP Betting as a Self-Enforcing Implicit Cartel

Adi Schnytzer and Avichai Snir, March 2011.

Testing for Home Team and Favorite Biases in the Australian Rules Football Fixed Odds and Point Spread Betting Markets

Adi Schnytzer and Guy Weinberg, March 2011.

The Impact of Insider Trading on Forecasting in a Bookmakers' Horse Betting Market

Adi Schnytzer, Martien Lamers and Vasiliki Makropoulou, March 2011.

The Prediction Market for the Australian Football League

Adi Schnytzer, March 2011.
2011-16  Information and Attitudes to Risk at the Track
Adi Schnytzer and Sara Westreich, March 2011.

2011-17  Explicit Evidence on an Implicit Contract
Andrew T. Young and Daniel Levy, March 2011.

2011-18  Globalization, Brain Drain and Development
Frédéric Docquier and Hillel Rapoport, March 2011.