Essays using economic methods

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Introducción

Este trabajo de investigación está compuesto por tres capítulos basados en tres disciplinas aplicadas habitualmente en economía: (*i*) econometría, (*ii*) teoría de juegos y (*iii*) economía experimental. Seguidamente definiremos cada una de ellas y analizaremos las relaciones que establecen entre sí.

i) Econometría: metodología cuyo objetivo es cuantificar relaciones a partir de los datos económicos. La econometría está definida como aquellas técnicas de análisis estadístico que utilizan los economistas, es decir, "*la econometría consiste en la aplicación de la estadística matemática a la información económica para dar soporte empírico a los modelos obtenidos por la economía matemática y obtener resultados numéricos*" (Tintner [13]).

En palabras de Samuelson [11], "*la econometría puede ser definida como el análisis cuantitativo de fenómenos económicos reales, basados en el desarrollo simultáneo de la teoría y la observación, relacionados mediante métodos apropiados de inferencia*".

La misión de la econometría es, básicamente, dar contenido empírico a la teoría económica. Se va a encargar, a partir de los *valores reales* de las variables económicas, de calcular los valores que tendrían los parámetros de los modelos en los que esas variables económicas aparecen o de verificar la validez de los modelos; también se ocupa de la evolución en el tiempo de las variables y de intentar predecir, con el mínimo error posible, los valores futuros de éstas.

En las últimas décadas, el estudio de la teoría econométrica se está convirtiendo en una parte esencial de la formación de los economistas.

ii) Teoría de juegos: "*un juego no es más que un proceso de interacción que envuelve a una población de individuos, que está sujeta a una serie de reglas y que tiene una colección de pagos preescrita asociada a cualquier posible resultado*" (Vega-Redondo [14]).

Expresado de un modo sencillo, la teoría de juegos pretende estudiar cuál es la decisión racional en un contexto en el que interactúan diversos agentes con intereses que pueden ser diferentes, y donde la decisión de un individuo puede influir no sólo en las decisiones de los demás, sino también en los resultados que los demás obtengan. Esta disciplina se encarga, por tanto, de simplificar problemas complejos de interacción estratégica entre dos o más agentes. Su objetivo no es el análisis del azar o de los elementos aleatorios sino el estudio de los comportamientos estratégicos de los jugadores. En el mundo real, tanto en las relaciones económicas como en las políticas o sociales, son muy frecuentes las situaciones en las que, al igual que en los juegos, el resultado depende de la conjunción de decisiones de diferentes agentes o jugadores. Se dice que un comportamiento es *estratégico* cuando se lleva a cabo teniendo en cuenta la influencia conjunta (de las decisiones propias y ajenas) sobre el resultado propio y ajeno.

Algunas de las aplicaciones más directas de la teoría de juegos son la organización industrial, modelos de negociación e intercambio o modelos de decisión multipersonales.

iii) Economía experimental: (en palabras de Vernon Smith [12], Premio Nóbel de Economía junto a Daniel Kanheman en el año 2002) los economistas

experimentales, "*tomamos proposiciones de la teoría económica y la probamos con gente real en situaciones controladas*". Es decir, la economía experimental trata de verificar las hipótesis, modelos o resultados que propone la teoría económica, de manera controlada, analizando el comportamiento llevado a cabo por sujetos reales en el laboratorio.

La economía experimental puede, en algunos casos, actuar de manera interdisciplinaria con la psicología para tratar de mejorar la comprensión de las decisiones económicas y del comportamiento humano. Desde un principio la economía experimental ha buscado testar teorías e hipótesis económicas inconclusas. La psicología ha ayudado a aumentar la comprensión del proceso individual de la toma de decisiones y hasta que punto se cumplen los axiomas básicos de comportamiento "racional" del *homo economicus*.

Uno de los objetivos políticos de la economía es el desarrollo de técnicas para diseñar mecanismos de mercado que deberían funcionar en el mundo real. Los experimentos son uno de los medios por los cuales probamos el buen funcionamiento de los mecanismos diseñados.

La economía experimental también es una herramienta que puede ser utilizada para mostrar a los reguladores cómo un mercado de precios reales podría y debería funcionar. Lo anterior implica que puede ser una buena herramienta para analizar políticas de competencia (ver, por ejemplo, Roth, Tayfun y Utku Unver [10]). Otra de sus aplicaciones está relacionada con el tema de las subastas, donde demuestra con gran poder las diferencias y consecuencias de diferentes mecanismos para subastar.

Una vez definidas las tres disciplinas, el siguiente paso es analizar las relaciones que se establecen entre ellas.

La primera que analizaremos será la relación entre la *teoría de juegos y la economía experimental*: la teoría de juegos propone una serie de modelos y resultados teóricos basados en hipótesis que pueden ser corroborados de manera empírica por la economía experimental. Efectivamente, los experimentos se pueden usar como herramientas para testar las hipótesis en las que se basan los modelos o para comprobar el modelo mismo, igualmente se utilizan experimentos para analizar si los resultados que predice la teoría son los que realmente ocurren (si los equilibrios perduran o si se converge a ellos). La economía experimental puede dar fuerza y respaldo a los modelos propuestos por la teoría.

Las *técnicas econométricas* sirven para dotar de contenido empírico a los modelos teóricos, cuantificando y concretando sus predicciones. Una vez que se ha propuesto un modelo, se utiliza la econometría para, bien analizando datos existentes o bien mediante simulaciones, comprobar su funcionamiento, veracidad o capacidad de predicción. Para analizar los datos obtenidos en los experimentos es bastante frecuente el uso de la econometría (y aquí aparece la tercera relación entre disciplinas) como método de trabajo. La anterior relación también se puede ver de manera inversa: a la hora de aplicar técnicas econométricas necesitaremos tener datos relevantes. En algunas ocasiones los datos necesarios para aplicar las citadas técnicas no existen en bases de datos ya generadas, por lo que tendremos que recurrir a la *economía experimental para su obtención*.

En resumen, la teoría de juegos se va a encargar de proporcionar los modelos

y las predicciones teóricas y, tanto la econometría como la economía experimental enriquecen la teoría de juegos mediante aportaciones empíricas, cuantificando y verificando sus predicciones.

Este estudio utiliza las tres disciplinas anteriormente descritas, y concretamente la tesis se distribuye como sigue. El primer capítulo se basa, de manera exclusiva, en técnicas econométricas, concretamente series temporales. El segundo es fundamentalmente un experimento de campo. El capítulo 3 estudia un juego de coordinación. Sin embargo el segundo capítulo tiene también una parte de econometría (sobre todo en el apéndice) y de teoría de juegos; y el tercero, si bien es un modelo teórico, tiene un mecanismo experimental y también econometría.

Tras esta introducción, a continuación presentamos el contenido de los tres trabajos de manera más detallada.

El primer capítulo se titula "*The effect of oil price on industrial production and on stock returns*" y está coautorado por Gabriel Pérez Quirós (Banco de España). En él se analiza un modelo *conjunto* para estudiar el impacto de shocks en los precios del petróleo, en la producción industrial y en los rendimientos de las acciones. Se compara el efecto de un incremento del precio del petróleo en la producción industrial y en la bolsa. Combinamos un modelo de Hamilton [4] de recesión y un modelo de Hamilton & Susmel [6] de cambios en el proceso *ARCH* caracterizando los rendimientos de las acciones. Siguiendo Hamilton & Lin [5] suponemos que existe un variable latente (el estado de la economía) que influye en la media de crecimiento de la producción industrial y en la escala de

la volatilidad de los acciones.

En esta línea, nuestro enfoque supone que la media de la producción industrial viene determinada por el estado de la economía y por los shocks en el precio del petróleo, mientras que la media de los rendimiento de las acciones vendrá afectada tan solo por los shocks en el precio del petróleo (afectando el estado de la economía solamente a la volatilidad).

El trabajo también investiga la influencia del precio del petróleo en la probabilidad de transición de un estado de la economía a otro, es decir, relaja la hipótesis de Hamilton [4] de que las probabilidades de transición son constantes y permitimos que dependan de retardos del incremento del precio del petróleo.

Los resultados muestran que incrementos en el precio del petróleo van a producir un efecto negativo en la bolsa y en la producción industrial. En el periodo inmediatamente posterior al shock, la bolsa experimenta una reacción a incrementos en el precio del petróleo tres veces mayor que la producción industrial. Cuatro periodos después, el efecto negativo del shock en el precio del petróleo sobre la producción industrial será dos veces mayor que el efecto sobre la bolsa. Es decir, la bolsa reacciona más rápidamente a los shocks en el precio del petróleo, pero el efecto del shock será mayor sobre la producción industrial (aunque en un periodo de tiempo mayor).

El capítulo 2 presenta el trabajo titulado "*Si él lo necesita: gypsy fairness in Vallecas*" y está coautorado por Pablo Brañas Garza (Universidad de Granada) y por Almudena Domínguez (INE). En este capítulo se estudia el comportamiento de una población muy concreta (gitanos no integrados de un

poblado en las afueras de Madrid) en un Ultimatum Game con Método Estratégico.

El Ultimatum Game (UG) es un juego de negociación entre dos jugadores propuesto por Güth et al. [3]. El primer jugador tiene que decidir como dividir una cantidad de dinero, concretamente en nuestro experimento 10 Euros, entre él mismo y el otro jugador. El segundo jugador podrá rechazar o aceptar la oferta del jugador 1 (proponente) con los siguientes pagos: (i) si el jugador 2 (receptor) acepta la oferta del jugador 1, entonces esa es la división final del dinero y (ii) si el jugador 2 rechaza la oferta del jugador 1 entonces los dos jugadores ganan 0.

Teóricamente, desde el punto de vista de los pagos, el jugador 2 aceptaría cualquier oferta que realizase el jugador 1 y éste propondría una división de 10-ε para él mismo y ε para el jugador 2, donde ε representa un número positivo.

El método estratégico modifica el juego estándar de la siguiente manera, el jugador 1 va a proponer la división del dinero (10 euros) y el jugador 2, antes de conocer la oferta del jugador 1 ha de decidir aquellas divisiones del dinero que aceptaría y cuáles rechazaría. Después se comprueba la oferta real del jugador 1 y lo que había dicho el jugador 2, efectuándose los pagos de la misma manera que en el Ultimatum Game estándar. La mayor ventaja de este método es que nos permite obtener una información más amplia acerca de las preferencias del jugador 2, ya que se analiza la reacción del receptor ante todas las posibles ofertas efectuadas por el proponente y no sólo su reacción a un valor concreto (en el ultimatum game normal sólo sabemos si aceptaría una oferta concreta y

no el rango completo de ofertas).

Las motivaciones que hay detrás de los sujetos (el oferente y el receptor) a la hora de jugar son diferentes: (i) el que ofrece puede tener motivaciones que van desde criterios de *justicia,* a *miedo* a que el receptor rechace la oferta si él considera que es abusiva; (ii) el receptor, a la hora de rechazar, además de maximizar sus pagos puede tener en cuenta criterios de justicia, si cree que la oferta no es adecuada es capaz de perder dinero para castigar al proponente. Por lo tanto con el UG podemos medir hasta qué punto el receptor es capaz de sacrificar su pago para infringir un castigo al proponente ante una oferta injusta.

Uno de los puntos de interés de este artículo está en la población que analiza: los gitanos no integrados de Madrid. Esta población es diferente de la población estándar utilizada en los experimentos (estudiantes), por lo que podemos considerar este trabajo como un experimento de campo (List [8]). Los gitanos, en España, son una población muy interesante para estudiar por diversos motivos; la raza gitana es una de las mayores minorías de este país y tradicionalmente ha sido un foco de problemas, además la opinión de la sociedad acerca de ellos no es muy favorable. Con este artículo lo que intentamos es acercarnos a esta población, y con ello conocer cuáles son los criterios de justicia y solidaridad que guían sus actuaciones (exclusivamente cuando actúan entre ellos y no cuando lo hacen ante "payos").

Los resultados muestran que, aunque los oferentes dividen el dinero de una manera igualitaria con sus receptores, cuando son estos mismos oferentes los que juegan el papel de receptores (de una forma hipotética) aceptan cualquier can-

tidad que les ofrezcan, movidos por un sentimiento de solidaridad con los otros individuos (lo que concuerda perfectamente con las reglas propias de este grupo étnico) y de deseo de maximización del bienestar social. El análisis econométrico muestra que las variables relacionadas con la educación, creencias religiosas y la integración social no influyen en la cantidad mínima que aceptan los individuos. El número de personas que vive en una casa y el número de invitados a comer tiene un efecto negativo en la cantidad mínima de dinero aceptada, mientras que variables como la pertenencia a un club o la asistencia a la iglesia tienen un efecto positivo en la cantidad mínima aceptada.

En el apéndice de este capítulo se recoge un segundo trabajo derivado del anterior sobre esta misma población titulado "*Inequality aversion among gypsies: a field investigation*" coautorado por Natalia Jiménez (Universidad de Granada). El trabajo realiza un estudio econométrico de las variables relevantes en la aversión a la desigualdad de los individuos de nuestra población. Mediante un procedimiento basado en el mecanismo propuesto por Kroll & Davidovitz [7], realizado de manera hipotética durante la misma sesión del experimento anterior, estudiamos la aversión a la desigualdad de los sujetos (gitanos).

El mecanismo consiste en que los individuos se enfrenten a una situación donde hay que repartir una cantidad de dinero entre una población, el mecanismo de reparto es aleatorio mediante el lanzamiento de un dado (de manera que sacar un uno en el dado implica la obtención de un euro, un dos la obtención de dos euros y así sucesivamente) y hay que decidir entre estas dos opciones: (i) se lanza el dado una única vez para todos los individuos, de manera que todos

van a ganar la misma cantidad de dinero o (ii) se lanza el dado una vez para cada uno de los jugadores, de manera que cada uno puede ganar una cantidad diferente a los demás (particularmente existe la posibilidad de que todos ganen lo mismo). Los individuos que eligen la opción (i) son considerados como aversos a la desigualdad mientras que los que eligen la opción (ii) son proclives a dicha desigualdad.

Usando un análisis logit, constatamos si la probabilidad de ser averso a la desigualdad está condicionada por atributos del sujeto revelados en una encuesta realizada durante el experimento. Los resultados más importantes encontrados son que las responsabilidades familiares y la religión incrementan la aversión a la desigualdad mientras que la educación hace a los individuos menos aversos a la desigualdad. No existe correlación entre la cantidad mínima aceptada por los sujetos en el Ultimatum Game con Método Estratégico y la medida de aversión a la desigualdad obtenida en el apéndice.

El tercer capítulo se titula "*An experimental device to elicit social networks*" y está coautorado por Pablo Brañas Garza y Natalia Jiménez (Universidad de Granada) y por Giovanni Ponti (Universidad de Alicante). Este trabajo propone un mecanismo que sirve para elicitar redes sociales latentes, es decir, las interconexiones entre sujetos. Lo más relevante es que tras la elicitación se abre todo un campo a la hora de analizar comportamientos estratégicos de los sujetos en los experimentos gracias a que disponemos de una variable no controlada hasta ahora: la situación en la que se encuentra el individuo en su entorno social.

La literatura acerca de las redes sociales no está muy desarrollada en el plano experimental. Este hecho es más latente desde el punto de vista de las redes endógenas, de hecho, la mayoría de los trabajos que hay son teóricos o con redes generadas artificialmente en un laboratorio. Los dos únicos trabajos que conocemos que siguen una línea parecida a la de este capítulo, son los de Mobius, Rosenthal y Quoc-Ann [9] y de Brañas-Garza, Durán y Espinosa [2].

El mecanismo consiste en un juego de coordinación, donde cada uno de los individuos de una clase tiene que decir el nombre y apellidos de sus amigos y conocidos, dándole, además, una valoración a la relación que va desde uno hasta cuatro (desde solamente conocidos hasta muy amigos). El juego introduce un castigo en el caso en el que se falle la coordinación, ya que el jugador perdería todo el pago. Es decir, el individuo perdería el premio si el individuo al que él nombra no le corresponde; o en el caso de que los dos sujetos se nombren mutuamente, fallan a la hora de valorar su relación.

Este mecanismo, además se ve refrendado por un modelo teórico que apoya los resultados obtenidos. Los resultados más relevantes son que el 75% de los links lanzados son correspondidos (y de esos el 80% son con una coincidencia exacta en la valoración), nadie dice que no tiene amigos y al menos un link lanzado por cada individuo es correspondido (ningún individuo lanza links de los que al menos uno no sea correspondido).

Como apéndice a este capítulo introducimos, a modo de aplicación, un análisis econométrico que pone de manifiesto la relación que hay entre las variables básicas del análisis de las redes sociales y el comportamiento altruista, medido

a través de la donación en un juego del Dictador. El trabajo se llama "*Social foundations of altruism: a note*" y está coautorado por Pablo Brañas Garza y Natalia Jiménez (Universidad de Granada) y por Giovanni Ponti (Universidad de Alicante). El juego del dictador ha sido analizado de manera exhaustiva en la literatura y funciona de la siguiente manera: el jugador 1 tiene que decidir como dividir una tarta (en nuestro caso 10 euros) entre él mismo y un jugador 2; el jugador 2 no tiene derecho a reclamar nada y se tiene que conformar con lo que el jugador 1 le ofrece. Como el jugador 2 no puede reclamar, se considera que cualquier donación positiva por parte del jugador 1 es un acto de generosidad[1].

Para estudiar el efecto de la integración social en el altruismo tomamos algunas medidas estándar en la literatura de redes que están relacionadas con la integración (como el clustering y el degree) y las donaciones llevadas a cabo en un juego del dictador realizado por los mismos individuos[2]

Los resultados obtenidos son: (*i*) bajo incertidumbre, la relación dictador/receptor no afecta a la donación y (*ii*) el clustering y el número de compañeros nombrados tienen un efecto positivo en la donación.

Lo más interesante del resultado anterior es que mostramos un comportamiento altruista, que no puede ser explicado por la reciprocidad, que está afectado por el nivel de integración social que poseen los sujetos.

[1] Observar que la diferencia entre éste y el UG es que en este juego el jugador 2 no tiene posibilidad de rechazar la propuesta del jugador 1.

[2] Los datos del juego del dictador fueron obtenidos algunos meses antes de elicitar la red social en un experimento de Brañas-Garza [1].

References

[1] Brañas-Garza P. (2006) Motivating helping behavior in dictator games with framing, *Mimeo*, ThE Papers 06/01.

[2] Brañas-Garza, P. Durán, M. and Espinosa, M. (2005) Do experimental subjects favor their friends? *Mimeo.*

[3] Güth, W., Schmittberger, R. and Schwarze, B. (1982) An experimental analysis of Ultimatum Bargaining, *Journal of Economic Behavior and Organization*, **3**: 367-388.

[4] Hamilton, J. (1989) A New Approach to Economic Analysis of Nonstationary Time Series and the Business Cycle, *Econometrica*, **57**: 357-384.

[5] Hamilton, J. and Lin, G. (1996) Stock Market volatility and the business cycle, *Journal of Applied Econometrics,* **11**: 573-593.

[6] Hamilton, J. and Susmel, R. (1994) Autoregressive Conditional Heteroskedasticity and changes in regime, *Journal of Econometrics,* **64**: 307-333.

[7] Kroll, Y. and Davidovich, L. (2003) Inequality aversion versus Risk aversion, *Economica,* **70**: 19-29.

[8] Harrison, G.W. and List, J.A. (2004) Field experiments, *Journal of Economic Literature,* **45**: 1009-1055.

[9] Mobius M., Rosenblat, T. and Quoc-Anh, R. (2005) Social Capital in Social Networks (manuscript in preparation). *Mimeo.*

[10] Roth, A. Tayfun, S. and Utku Unver, M. (2005) A kidney exchange clearinghouse in New England, *American Economic Review,* **95**: 376-380.

[11] Samuelson, P.A. Koopmans, T.C. and Stone, J.R.N. (1954) Report of the evaluative committee for Econometrica, *Econometrica,* **22**: 141-156.

[12] Smith, V. (2002) Entrevista concedida a la Reason Magazine.

[13] Tintner, G. (1968) Methodology of Mathematical economics and econometrics. *The University of Chicago press*, page 74.

[14] Vega-Redondo, F. (2003) Economics and the theory of Games. *Cambridge University press.*

Capítulo 1: Oil Price

The effect of oil price on industrial production and on stock returns

Introduction

A large body of research suggests that oil price variations have strong consequences on economic activity. Oil price increase is considered bad news in oil importing countries. An increase in oil price leads to a rise in production costs, because oil is a basic input in the production process. Moreover, oil price increases have a negative effect on investment by increasing firms' costs.

There are two distinguishing features of oil in the post war world economy. The first one is that oil is a major resource that has been used around the world. Second, oil price hikes in the post war era appear to be dominated by shocks exogenous to the rest of the economy, specifically by strike activity and coal prices. Hamilton [7] studies the oil price changes in US and concludes that "... derived from events which truly were exogenous with respect to the American economy, such that the nationalization of Iranian assets, the Suez crisis, the secular decline in energy reserves, strikes by oil and coal workers, and other economic developments specific to the energy sector".

Hamilton [7] finds that all but one of the US recessions since WWII have been precede by a dramatic increase in the price of crude petroleum, although this does not mean that oil shocks causes these recessions, there is evidence that oil shocks were a contributing factor in at least some of the US recessions prior to 1972.

Mork [14] pays particular attention to the possibility of asymmetric responses to oil prices increases and decreases and finds that there exists a statistically significant negative correlation between GDP and oil price increases and a statistically insignificant correlation between GDP and decreases in the real price of oil.

Mork, Olsen and Mysen [15] show that oil shocks affect the GDP in US, Japan, Germany, Canada, France, UK and Norway; while the effects are the strongest for US, Japan and Norway.

The related empirical studies started by finding a linear negative relationship between oil prices and real activity in oil importing countries. Raymond and Rich [17] develop a Markov switching model to analyze the relationship between oil price shocks and the GDP growth and find that the principal channel of effect of oil prices is on the mean of low-growth phases of output rather than the transitional probabilities between growth states.

If oil affects real output, increases in oil price depress aggregate stock prices by lowering expected earnings. This suggests that oil prices shocks should be associated with stock returns. Sadorsky [18] concludes that changes in oil prices impact economic activity but, changes in economic activity have little impact in oil prices.

Jones and Kaul [13] conclude that changes in oil prices that granger-precede most economic series, have an effect on output and real stock returns in the United States. Ciner [3] finds that oil shocks impact stock index returns in a nonlinear fashion.

If we have a look to the evolution for the oil price from 1989 to now, we observe that in last years oil price is increasing continuously. This paper studies the real impact of these increases in oil price on stock market and compares this reaction of stock markets with the reaction of industrial production to analyze if the stock market reacts more rapidly than industrial production.

This paper analyzes a joint model to study the impact of shocks in oil prices on industrial production and the impact of shocks in oil prices on stock returns. We compare the effect of an increase of oil price on industrial production and on stock returns. We combine Hamilton's [11] model of recession and Hamilton and Susmel's [12] model of changes in the ARCH process characterizing stock returns. Following Hamilton and Lin [9] we hypothesize that there is a single latent variable (the state of the economy) which determines both the mean of industrial production growth and the scale of stock volatility.

So, we think that the mean of industrial production will be determined by the state of the economy and the shocks in oil prices, while the mean of the stock returns will be only affected by shocks in oil prices and the state of the economy only has an effect on the volatility.

This paper investigates too the influence of the oil price on the transition probability from one state of the economy to other, i.e. we relax the assumption in Hamilton [11] that the state transition probabilities are constant and instead allow them to depend on lagged real oil price increases.

The results demonstrate that oil price has a negative influence on industrial production and on stock returns and they illustrate that the stock market reacts

in a stronger way than industrial production to raises in oil price. Oil price has an effect on transition probabilities.

The structure of the paper is as follows: in section 2 we present the model, section 3 shows the empirical results and section 4 concludes.

The model

The model for the industrial production, following Hamilton [11] is as follows:

$$\begin{aligned} y_t &= z_t + \mu_{st}. \\ \mu_{st} &= \gamma_{st} + \alpha_1 \times oil_{t-1} + \alpha_2 \times oil_{t-2} + ... + \alpha_m \times oil_{t-m}. \\ z_t &= \phi_1 \times z_{t-1} + \phi_2 \times z_{t-2} + ... + \phi_q \times z_{t-q} + \epsilon_t. \end{aligned}$$

where:

y: monthly growth rate of an aggregate index of industrial production.

Oil: monthly growth rate of oil price.

ϵ_t is assumed to be $i.i.d.$ N(0,σ^2).

In this specification s_t is an unobserved latent variable that reflects the state of the business cycle. In the general case we allow s_t to assume one of the K different values represented by the integers (0, 1, 2,..., K). In this particular model, for simplicity we assume that there exist only two states of the business cycle, expansions and recessions.

This model assumes that industrial production follows the nonlinear specification suggested by Hamilton [11], i.e., the process is subject to discrete shifts in

regime—episodes across which the dynamics behavior of the series is markedly different. This specification has been used by many authors and the results show that this model is a good description of the behavior of industrial production[3].

Following Hamilton and Susmel [12], we establish the next specification for stock returns:

$$
\begin{aligned}
r_t &= \delta_0 + \delta_1 \times r_{t-1} + \delta_2 \times r_{t-2} + ... + \delta_n \times r_{t-n} + \\
&\quad + \beta_1 \times oil_{t-1} + \beta_2 \times oil_{t-2} + ... + \beta_m \times oil_{t-m} + e_t. \\
e_t &= \sqrt[2]{g_{sd} * u_t}. \\
u_t &= \sqrt[2]{h_t * w_t}. \\
h_t &= \zeta_0 + \zeta_1 * u_{t-1}^2 + \zeta_2 * u_{t-2}^2 + ... + \zeta_s * u_{t-s}^2 + \eta * u_{t-1}^2 * I_{t-1}.
\end{aligned}
$$

where:

r: monthly excess returns on S&P 500.

$w_t \rightarrow$ N(0,1).

This model uses an ARCH specification that has been used by many authors in the literature. We have changed this basic specification to improve the model's capacity to describe the stock return series.

We assume that changes in the state of the economy affect the volatility

[3] We have study the specification in which the variance of the growth rate of industrial production is a function of the state of the economy. The model is as follows:
$y_t = z_t + \mu_{st}$;
$\mu_{st} = \gamma_{st} + \alpha_1 * oil_{t-1} + \alpha_2 * oil_{t-2} + \ldots + \alpha_m * oil_{t\_m}$;
$z_t = \phi_1 * z_{t-1} + \phi_2 * z_{t-2} + ... + \phi_q * z_{t-q} + \sigma_{st}\epsilon_t$; with $\epsilon_t \rightarrow$ N(0,1).
The empirical results show that this variance is not statistically significant, so we develop only the case in which the state of the economy affects the mean of industrial production.

of the stock market. The reason for this assumption is that the tendency of the stock market volatility to exhibit episodic variations, is a well documented feature of this series and, given the limited predictability of stock returns, it is surely a mistake to overparameterice the mean of rt.

In this case s_d is an unobserved latent variable that represents the volatility phase of the stock market. For g_{sd} not identically equal to unity, u_t is multiplied by a scale factor g_{sd} representing the current phase s_d that characterizes overall stock volatility. The variable u_t is then multiplied by the constant $\sqrt[2]{g_1}$ when the process is in the regime represented by $s_d = 1$ and multiplied by $\sqrt[2]{g_0}$ when $s_d = 0$. We will normalize g_1 to 1, so g_0 shows us the average variance of stock returns when we are in state 0.

Black [2] and Nelson [16] have given evidence that the asymmetric effect of stock price increases and decreases on volatility is a very important feature of the stock return data. For this reason, the error in the specification for stock returns, e_t, follows a L-ARCH process, which introduce the leverage effect. With this structure we are going to study if increases or decreases in the stock price could have asymmetric effects in the volatility.

In the previous specification, we can see that ht is given by

$$h_t = \zeta_0 + \zeta_1 * u_{t-1}^2 + \zeta_2 * u_{t-2}^2 + \ldots.. + \zeta_s * u_{t-s}^2 + \eta * u_{t-1}^2 * I_{t-1}$$

for u_{t-1}^2 as specified in table 1 in appendix 2, and

$$I_{t-1} = \left\{ \begin{array}{l} 1 \text{ if } e_{t-1} < 0 \\ \\ 0 \text{ if } e_{t-1} > 0 \end{array} \right\}$$

With this specification for I_{t-1} we observe that if $\eta > 0$, a stock price decrease has a greater effect on subsequent volatility that would a stock price increase of the same magnitude. With this definition for h_t we introduce in the model the leverage effect, which is the possibility that stock prices decreases and increases could have asymmetric effects on subsequent volatility. This parameterization of the leverage effect was proposed by Glosten, Jagannathan and Runkle [6].

Such a model requires a formulation of the transition probability from one state to another. Following Hamilton [11], we establish that this probability is given by a K-state Markov chain:

$$Prob(s_t = i | s_{t-1} = j, s_{t-2} = k, \ldots..) = prob(s_t = i | s_{t-1} = j) = p_{ji}.$$

We assume that the transition probability only depends on the state in the previous period and it does not depend on the state before one lag. Some authors as Hamilton and Lin [9] and Diebold and Rudebusch [4] have used this assumption and it seems to be a good representation of historical experience.

We are going to describe the connection between the phase of the business cycle (s_t) and the phase of the stock volatility (s_d). We study two different

cases: in case 1 the phase of the business cycle (s_t) and the phase of the stock volatility (s_d) are the same. In case 2, both states (s_t and s_d) are independent.

Following Hamilton and Lin [9], we establish that m, n, s and q are equal to 1. For example, if we are in case 1, we will have four states of nature:

$s_f = 1$ if $s_t = 1$ and $s_{t-1} = 1$;

$s_f = 2$ if $s_t = 1$ and $s_{t-1} = 0$;

$s_f = 3$ if $s_t = 0$ and $s_{t-1} = 1$;

$s_f = 4$ if $s_t = 0$ and $s_{t-1} = 0$.

This mean that if we have for example that s_f=2, the state of the economy in period t is 1 (we can assume that 1 is expansion and 0 is recession) and the state in period t-1 is 0, this is, we pass from an state of recession to an state of expansion and this change occurs for industrial production and stock returns.

Let P be a matrix whose row j, column i entry is the probability Prob($s_f = j|s_{f-1} = i$)

$$P = \begin{pmatrix} p_{11} & p_{11} & 0 & 0 \\ p_{10} & p_{10} & 0 & 0 \\ 0 & 0 & p_{01} & p_{01} \\ 0 & 0 & p_{00} & p_{00} \end{pmatrix}$$

Let $x_t = (y_t, r_t)'$ be a (2x1) vector containing the growth rate of industrial production and the excess return on stocks, and consider the vector process:

$$\begin{aligned} x_t &= \theta_{sf} + \rho_1 * x_{t-1} + \rho_2 * x_{t-2} + \ldots .. + \rho_q * x_{t-q} + \\ &\quad + \delta_1 * oil_{t-1} + \delta_2 * oil_{t-2} + \ldots . + \delta_s * oil_{t-s} + L_{t,sf} \times v_t. \end{aligned}$$

For the case which we are going to study, we can say that ρ_j is a diagonal matrix given by:

$$\rho_j = \begin{pmatrix} \phi_j & 0 \\ 0 & \delta_j \end{pmatrix}$$

In the above equation v_t is assumed to be N(0, I^2), with I^2 being a (2x2) identity matrix. For the other parameters, we show the values in the appendix in table 1 for case 1, in which s_t and s_d are the same.

To compute the parameters for this specification, we will evaluate the log likelihood of the observed data,

$$L = \sum logf(x_t|x_{t-1}, x_{t-2}, \dots, x_{-q}; \gamma)$$

where

$$\begin{aligned} f(x_t|x_{t-1}, x_{t-2}, \dots, x_{t-q}, s_f) &= (2\pi)^{-1}|L_t, s_f|^{-1} exp(-1/2 * \xi\prime_{t,s_f}\xi_{_{t,s_f}}). \\ \xi_{t,sf} &= L^{-1}_{_{t,sf}}(x_t - \theta_{sf} - \rho_1 * x_{t-1} - \dots - \rho_q * x_{t-q}) \end{aligned}$$

To evaluate the log likelihood we will use the method described by Hamilton [8], where γ is a vector of population parameters containing the unknown elements of $P, \rho_j, \theta_{sf}, L_{t,sf}$.

The resulting maximum likelihood estimates from above can be used to form an inference about the latent state of the form Prob($s_f = 1|x_t, x_{t-1}, \dots, x_1; \gamma$).

In case 1 probability of being in a recession is given by the expression,

$$\begin{aligned} Prob(s_t &= 0|x_t, x_{t-1}, \ldots, x_1; \gamma) = \\ &= Prob(s_f = 3|x_t, x_{t-1}, \ldots, x_1; \gamma) + Prob(s_f = 4|x_t, x_{t-1}, \ldots, x_1; \gamma). \end{aligned}$$

In case 2 probability of being in a recession can be computed as:

$$\begin{aligned} Prob(s_t &= 0|x_t, x_{t-1}, \ldots, x_1; \gamma) = Prob(s_f = 9|x_t, x_{t-1}, \ldots, x_1; \gamma) + \\ +Prob(s_f &= 10|x_t, x_{t-1}, \ldots, x_1; \gamma) + Prob(s_f = 11|x_t, x_{t-1}, \ldots, x_1; \gamma) + \\ +Prob(s_f &= 12|x_t, x_{t-1}, \ldots, x_1; \gamma) + Prob(s_f = 13|x_t, x_{t-1}, \ldots, x_1; \gamma) + \\ +Prob(s_f &= 14|x_t, x_{t-1}, \ldots, x_1; \gamma) + Prob(s_f = 15|x_t, x_{t-1}, \ldots, x_1; \gamma) + \\ +Prob(s_f &= 16|x_t, x_{t-1}, \ldots, x_1; \gamma) \end{aligned}$$

Empirical results

We use monthly data from January 1963 to May 2004.

The transformations that we have done to the data in this analysis are shown in appendix 1.

Here we describe only some of the most important features of the data. Following Hamilton and Lin, we are going to use real stock returns throughout our analysis. We measure the real of return on common stocks as the difference between the S&P 500 and the inflation rate calculated using the consumer price index.

For oil price we use a transformation following Hamilton [10]. He proposed

a net oil price increase variable that relates the current price of oil to its value over the previous year rather than the previous month. Specifically the variable is defined to be equal to the percentage change in the current real price of oil from the previous year's maximum if positive and zero otherwise. With this transformation Hamilton improves Mork's modification [11] to study the asymmetric effects of increases and decreases of oil price on the economy. This calculation makes clear that most of the individual price increases since 1986 were simply corrections to earlier declines. The reason is that if someone wants a measure of how unsettling an increase in the price of oil is likely to be for the spending decisions of consumers and firms, it seems more appropriate to compare the current price of oil with where it has been over the previous year rather than during the previous month alone.

Table 2 shows the results for cases 1 and 2, under the following conditions: $q = m = s = 1$ and we have only two phases of the business cycle, expansion and recession. We will impose that $\zeta_o > 0$ and ζ_1 and $\eta \geq 0$; with this restriction we assure that h_t is going to be positive and the variance in the second equation will be positive too. For this last affirmation we need the condition that g_0 is going to be also positive.

In case 1 equations share the same state of the economy, this is, case 1 imposes the restriction that $p_{sd} = p_{st}$. Case 1 allows for dependence between r_t and y_t through their common dependence on the unobserved state s_t. We can see that oil price has a negative and statistically significant effect on industrial production ($\alpha_1 = -0.0056$) but the negative effect of oil price is stronger on

stock returns ($\beta_1 = -0.017$). So, in current period, the effect of shocks in oil prices on stock returns is three times higher than the effect on industrial production, but after three periods the effect changes and it is two times higher on industrial production than on stock returns.

This negative relation between oil price increase and stock returns could be expected because, as we have said before, oil price increases are bad news in oil importing countries since oil is a very important resource for these nations. This increase in the price of the resources will raise firms' costs and will reduce the expected earnings. All these effects could affect the stock returns in a negative way.

The reason for this stronger effect of oil price on stock returns than on industrial production is that the stock market reacts more rapidly than the industrial production to changes in the economic situation. When oil price increases, the stock market reacts immediately to this situation but the industrial production is not as flexible as stock market and the immediate reaction to the change is lower.

We observe that the parameter ζ_1 from the expression for h_t converges to zero. We dropped the parameter ζ_1 from the model, concluding that, for this data set, the only arch effects are those caused by downwards movements in stock prices, as captured by the parameter η.

Table 2: Results for cases 1, 2 and 4.

Table 2 shows the maximum likelihood estimates for the model:

$y_t = z_t + \mu_{st}$;

$\mu_{st} = \gamma_{st} + \alpha_1 \times oil_{t-1} + \alpha_2 \times oil_{t-2} + ... + \alpha_m \times oil_{t-m}$;

$z_t = \phi_1 \times z_{t-1} + \phi_2 \times z_{t-2} + ... + \phi_q \times z_{t-q} + \epsilon_t$;

$r_t = \delta_0 + \delta_1 \times r_{t-1} + \delta_2 \times r_{t-2} + ... + \delta_n \times r_{t-n} + \beta_1 \times oil_{t-1} + \beta_2 \times$

$\times oil_{t-2} + ... + \beta_m \times oil_{t-m} + e_t$;

$e_t = \sqrt[2]{g_{sd} * u_t}$;

$u_t = \sqrt[2]{h_t * w_t}$;

$h_t = \zeta_0 + \zeta_1 * u_{t-1}^2 + \zeta_2 * u_{t-2}^2 + ... + \zeta_s * u_{t-s}^2 + \eta * u_{t-1}^2 * I_{t-1}$;

where y_t is the industrial production, z_t is the stock return and oil_t is the oil price in period t. ϵ_t is assumed to be $i.i.d.$ N(0,σ^2) and w_t is assumed to be $i.i.d.$ N(0,1). Standard errors are in parenthesis. The transition probabilities are constant; they do not depend on oil prices. In case 1 both equation share the state of the economy. In case two the states of the economy are independent. Case 4 is a mixture of cases 1 and 2 with ψ being the weight of case 1 and $(1 - \psi)$ the weight of case 2.

Parameters	Case 1	Case 2	Case 4
γ_1	-0.003(0.001)	0.004 (0.0004)	0.004 (0.0004)
γ_0	0.004(0.0004)	-0.008 (0.001)	-0.006 (0.001)
ϕ_1	0.18(0.05)	0.18 (0.04)	0.14 (0.04)
α_1	-0.005(0.001)	-0.006 (0.0015)	-0.005 (0.002)
δ_0	0.004(0.002)	0.004 (0.002)	0.005 (0.002)
δ_1	0.11(0.05)	-0.003 (0.06)	-0.015 (0.004)
β_1	-0.02(0.009)	-0.02 (0.01)	-0.02 (0.008)
g_0	0.31(0.05)	0.21 (0.04)	3.93 (0.69)
σ	0.006(0.0002)	0.006 (0.0002)	0.006 (0.0002)
ζ_0	0.004(0.0007)	0.002 (0.0001)	0.001 (0.0002)
ζ_1	$6.69*10^{-11}$(0.03)	$4.55*10^{-12}$ (0.11)	$6.54*10^{-11}$ (0.08)
η	0.06(0.008)	0.17 (0.14)	0.11 (0.09)
$Prob(rec)IP$	0.86(0.05)	0.81 (0.07)	0.86 (0.06)
$Prob(exp)IP$	0.96(0.015)	0.97 (0.01)	0.97 (0.01)
$Prob(rec)SR$	—	0.98 (0.07)	$6.95*10^{-11}$ (2.41)
$Prob(exp)SR$	—	0.96 (0.02)	$4.87*10^{-12}$ (2.38)
ψ	—	—	0.82 (0.36)
$log-likelihood$	2628.17	2633.28	2638.22

Case 2 imposes that the state governing the industrial production (s_t) and the state governing stock volatility (s_d) are independent, this is, in this case r_t and y_t are completely independent. We observe that the effect of oil price on in-

dustrial production is, as in the case above, negative and statistically significant ($\alpha_1 = -0.0064$) but a little stronger than in case 1. Here, we can see too that the influence of oil price on stock returns is negative and statistically significant ($\beta_1 = -0.01734$) and is more or less three times higher than the effect of oil price on industrial production.

This case shows the same situation than before, i.e., ζ_1 converges to zero. So here we say that, as in the case 1, the only ARCH effect is given by the parameter η.

We have tried to compare these two models to see which one is better. To study this problem, we have followed a method given by Bengoechea and Perez Quirós [1]. The idea is the following, we have two extreme situations; in the first one we estimate a model where industrial production and stock returns share the same state of the economy. In the second situation the state governing the industrial production (s_t) and the state governing stock volatility (s_d) are independent.

Assuming that we have only two states of economy, expansion and recession, we have four basic states:

$$s_t = 1, s_d = 1;$$

$$s_t = 1, s_d = 0;$$

$$s_t = 0, s_d = 1;$$

$$s_t = 0, s_d = 0.$$

The probability of being in one of these basic states depends on the situation in which we are. If we are in the first situation, where the variables share the

state of the economy, the probability would be the following,

$$\begin{aligned} P(s_t &= 1, s_d = 1) = P(s_t = 1) \\ P(s_t &= 1, s_d = 0) = 0 \\ P(s_t &= 0, s_d = 1) = 0 \\ P(s_t &= 0, s_d = 0) = P(s_t = 0). \end{aligned}$$

On the other hand, the probability of being in these four states when the states of the economy are independent is as follows,

$$\begin{aligned} P(s_t &= 1, s_d = 1) = P(s_t = 1) * P(s_d = 1) \\ P(s_t &= 1, s_d = 0) = P(s_t = 1) * P(s_d = 0) \\ P(s_t &= 0, s_d = 1) = P(s_t = 0) * P(s_d = 1) \\ P(s_t &= 0, s_d = 0) = P(s_t = 0) * P(s_d = 0). \end{aligned}$$

The only difference between sharing or not the state of the economy is in the form of the transition probabilities. We want to study what is the best model. The true data maybe would be between these two extreme situations. To find this intermediate point Bengoechea and Pérez Quirós propose the following

transition probabilities:

$$\begin{pmatrix} P(s_t{=}\,1, s_d{=}\,1) \\ P(s_t{=}\,1, s_d{=}\,0) \\ P(s_t{=}\,0, s_d{=}\,1) \\ P(s_t{=}\,0, s_d{=}\,0) \end{pmatrix} = \psi \begin{pmatrix} P(s_t{=}\,1) \\ 0 \\ 0 \\ P(s_t{=}\,0) \end{pmatrix} + (1-\psi) \begin{pmatrix} P(s_t{=}\,1) * P(s_d{=}\,1) \\ P(s_t{=}\,1) * P(s_d{=}\,0) \\ P(s_t{=}\,0) * P(s_d{=}\,1) \\ P(s_t{=}\,0) * P(s_d{=}\,0) \end{pmatrix}.$$

In this case the most important parameter is ψ. If ψ is close to 1, this shows that we are closer to the assumption of sharing the state of the economy. If, on the contrary, we are closer to the independence of the states, the ψ will be around 0.

We estimate this last specification and the results are shown in the third column of table 2. If we have a look to the results for this last case we can see that ψ is close to 1 ($\psi = 0.8276$), so this mean than the assumption that they share the business cycle is closer to reality than the independence of the business cycle.

Previous cases impose that the transition probabilities are constant in the sense that they do not depend on any variable. Case 3 develops the model as in case 1 but assuming that the transition probabilities depend on one lag of the oil price. What we assume is that

$$\begin{aligned} Prob(s_t &= 1|s_{t-1} = 1) = p_t = \lambda_0 + \lambda_1 * oil_{t-1} \\ Prob(s_t &= 0|s_{t-1} = 0) = q_t = \tau_0 + \tau_1 * oil_{t-1} \end{aligned}$$

Results for this last case are shown in table 3.

Table 3:. Results for case 3

Table 3 shows the maximum likelihood estimates for the model:

$$y_t = z_t + \mu_{st}$$

$$\mu_{st} = \gamma_{st} + \alpha_1 * oil_{t-1} + \alpha_2 * oil_{t-2} + \ldots + \alpha_m * oil_{t-m}$$

$$z_t = \phi_1 * z_{t-1} + \phi_2 * z_{t-2} + \ldots. + \phi_q * z_{t-q} + E_t$$

$$r_t = \delta_0 + \delta_1 * r_{t-1} + \delta_2 * r_{t-2} + \ldots.. + \delta_n * r_{t-n}$$

$$+\beta_1 * oil_{t-1} + \beta_2 * oil_{t-2} + \ldots.. + \beta_m * oil_{t-m} + e_t$$

$$e_t = \sqrt[2]{g_{sd}} * u_t$$

$$u_t = \sqrt[2]{h_t * w_t}$$

$$h_t = \zeta_0 + \zeta_1 * u_{t-1}^2 + \zeta_2 * u_{t-2}^2 + \ldots.. + \zeta_s * u_{t-s}^2 + \eta * u_{t-1}^2 * I_{t-1}$$

where y_t is the industrial production, z_t is the stock return and oil_t is the oil price in period t. Et is assumed to be i.i.d. N(0,σ^2) and w_t is assumed to be i.i.d. N(0,1). Standard errors are in parenthesis. The transition probabilities are given by $Prob\ (s_t = 1|s_{t-1} = 1) = p_t = \lambda_0 + \lambda_1 * oil_{t-1}$ and $Prob\ (s_t = 0|s_{t-1} = 0)\ = q_t = \tau_0 + \tau_1 * oil_{t-1}$.

Parameters	Case 3
γ_1	-0.0022 (0.001)
γ_0	0.004 (0.0005)
ϕ_1	0.22 (0.05)
α_1	-0.004 (0.002)
δ_0	0.005 (0.002)
δ_1	-0.09 (0.05)
β_1	-0.02 (0.01)
g_0	0.29 (0.06)
σ	0.006 (0.0002)
ζ_0	0.004 (0.0007)
ζ_1	5.69*10-11 (0.062)
η	0.04 (0.012)
$Prob(rec)$ constant	-3.27 (0.77)
$Prob(exp)$ constant	6.45 (1.52)
$Prob(rec)$ λ_1	7.92 (2.30)
$Prob(exp)$ τ_1	-7.61 (1.79)
ψ	0.82 (0.23)
$log - likelihood$	2625.21

The results in this case show that the assumption about the transition probability is good because the coefficients of oil price in the probabilities are sta-

tistically significant. We see that oil price effect on transition probability from expansion to expansion is negative and statistically significant (-7.609), this mean that an increase in oil price reduce the probability of remaining in expansion. For the transition probability of remaining in a recession, the effect of oil price is positive and statistically significant (7.906), so we can say that if oil price increases the probability of continuing in a recession will be higher.

These results are as we could expect because from an economic point of view it is very intuitive to think that if oil price increases, this affect to the economy and the probability of remaining in an expansion falls.

Related to the influence of oil prices on industrial production and stock returns, we observe a behavior similar to case 1; there exists a negative and statistically significant influence of oil prices on both variables, although the effect of oil price on stock returns is higher than on industrial production.

Figure 1 shows the raw data for industrial production and stock returns used in this analysis. The bottom panel plots the probability of being in recession that we have computed in case 1.The shaded areas shows NBER recessions. The idea is that in recession the industrial production is lower than in expansions and the stock market volatility will be higher. The correspondence between econometric inference and the NBER dating of economic recessions is remarkable.

Conclusions

This paper analyzes the relationship between oil price and the stock market and between oil price and industrial production. The aim of this work is to

study which relationship is stronger, i.e., which variable reacts more rapidly to increases in oil price.

For this purpose, we establish a specification assuming that there exists a single latent variable (the state of the economy) which determines the mean of industrial production growth and the scale of the stock returns volatility.

Results show that an increase in oil price has a negative effect on industrial production and on stock market. In the immediate period after the shock, stock returns have a reaction to increases in oil price three times higher than the reaction of industrial production. However, four periods after the shift, this reaction will vary and the response of industrial production to changes in oil price will be two times higher than the response of stock returns to these variations in oil price. These results illustrate that stock market reacts more rapidly than the industrial production to raises in oil price, but in a long period, the effect on industrial production will be higher than on stock returns.

Finally, empirical results prove that increases in oil price have a negative effect on the probability of remaining in expansion and they have a positive effect on the probability of being in a recession.

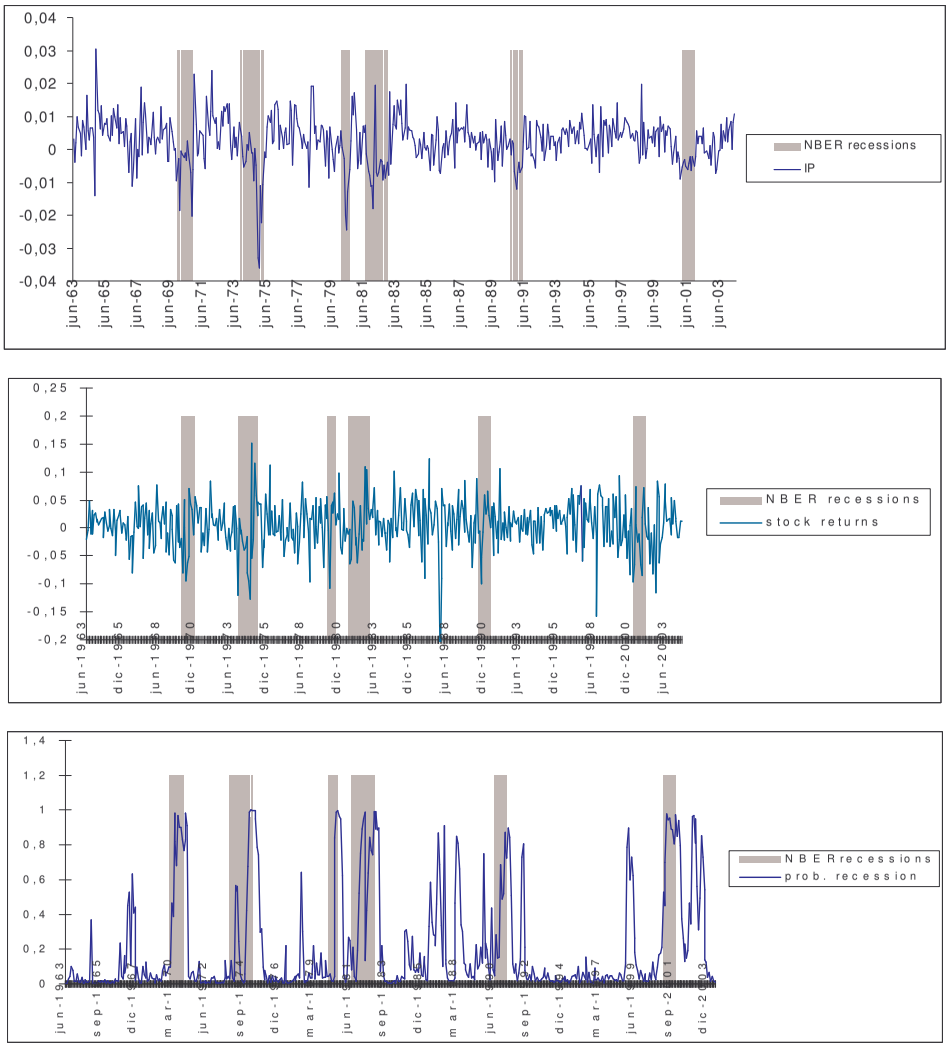


Figure 1: (a) Rate of growth of industrial production (monthly rate)

(b) excess return on S&P500 stock price index (monthly rate)

(c) probability of being in recession at date t

(*) Shaded areas show NBER recessions.

References

[1] Bengoechea, P. and Perez-Quiros, G. (2004) "A useful tool to identify recessions is the Euro-area". *Mimeo.*

[2] Black, F. (1976) "Studies of stock market volatility changes", *Proceedings of the American Statistical Association, Business and Economic Statistic Section.*

[3] Ciner, C. (2001) 'Energy shocks and Financial Markets: Nonlinear Linkages', *Northeastern University working paper.*

[4] Diebold, F. X. and Rudebusch G. (1990) "A nonparametric investigation of duration dependence in the American business cycle", *Journal of Political Economic*, **98**, 596-616.

[5] Diesprong, G., Jacobsen, B. and Maat, B. (2003) "Striking Oil: another puzzle", *Rotterdam School of management working paper.*

[6] Glosten, L., Jagannathan, R. and Runkle D. (1993) "On the relation between the expected value and the volatility of the nominal excess return on stocks", *Journal of Finance*, **48**, 1779-1801.

[7] Hamilton, J. D. (1983) "Oil and the Macroeconomy since World War II", *The Journal of Political Economy*, **91**, 228-248.

[8] Hamilton, J. D. (1994) "Time Series Analysis", *Princeton University Press.*

[9] Hamilton, J. D. and Lin, G. (1996) "Stock Market volatility and the business cycle", *Journal of Applied Econometrics* **11**, 573-593.

[10] Hamilton, J. D. (1996) "This is what happened to the oil price Macroeconomy relationship" *Journal of Monetary Economics* **38**, 215-220.

[11] Hamilton, J. D. (1989) "A New Approach to Economic Analysis of Nonstationary Time Series and the Business Cycle" *Econometrica*, **57**, 357-384.

[12] Hamilton, J. D. and Susmel, R. (1994) "Autoregressive Conditional Heteroskedasticity and changes in regime", *Journal of Econometrics*, **64**, 307-333.

[13] Jones, C. M. and Kaul, G. (1996) "Oil and the stock market", *The Journal of Finance*, **51**, 463-491.

[14] Mork, K. A. (1989) "Oil and the Macroeconomy When Prices Go Up and Down: an extension of Hamilton's results", *The Journal of Political Economy*, **97**, 740-744.

[15] Mork, K. A., Olsen O. and Mysen H. T. (1994) "Macroeconomic Responses to oil price increases and decrease is seven OECD countries", *Energy Journal*, **15**, 19-35.

[16] Nelson, D. (1991) "Conditional heteroskedasticity in asset returns: a new approach", *Econometrica*, **59**, 347-370.

[17] Raymond, J. E. and Rich, R. (1997) "Oil and the Macroeconomy: a Markov State-Switching approach", *Journal of Money, Credit and Banking*, **29**, 193-213.

[18] Sadorsky, P. (1999), "Oil price shocks and stock market activity", *Energy Economics*, **21**, 449-469.

Appendix 1

We summarize briefly the transformations applied on variables in the following table 1.

Variable	Raw data series	Transformations used
inflation	Consumer price index	First differences in the logarithms of the index
Oil shocks	UK Brent	
Stock returns	Aggregate stock market indexes (S&P500)	First differences in the logarithms of the index
Real stock returns		Stock returns-inflation
Industrial production	Index of industrial production	First differences in the logarithms of the index

Appendix 2

Table 1: Meaning of parameters for case 1.

Meaning of parameters in the case where the equations for industrial production and for stock returns share the state of the economy.

s_f	θ_{sf}	$L_{t,sf}$	$u^2_{t-1,sf}$
1	$\gamma_1 - \phi_1 * \gamma_1$	σ 0	e^2_{t-1}/g_1
	δ_0	0 $\sqrt[2]{g_1 * h_t}$	
2	$\gamma_0 - \phi_1 * \gamma_1$	σ 0	e^2_{t-1}/g_0
	δ_0	0 $\sqrt[2]{g_1 * h_t}$	
3	$\gamma_1 - \phi_1 * \gamma_0$	σ 0	e^2_{t-1}/g_1
	δ_0	0 $\sqrt[2]{g_0 * h_t}$	
4	$\gamma_0 - \phi_1 * \gamma_0$	σ 0	e^2_{t-1}/g_0
	δ_0	0 $\sqrt[2]{g_0 * h_t}$	

Capítulo 2: Field experiments

Si el lo necesita: gypsy fairness in Vallecas

Introduction

A great many authors from varying disciplines have studied the driving forces behind individuals' social behavior (see for example Bateson and Shaw [3], Camerer [7] and Rabin [21]). Interestingly, experimental evidence suggests that the canonical assumption of selfishness does not accurately represent individual behavior (see Henrich [16] and Henrich *et al.* [17]). Bolton and Ockenfelds [4], Charness and Rabin [8], Fehr and Schmidt [10] or Rabin [20] propose new models in which equity, reciprocity or fairness substitute the standard selfish behavior.

In most human societies a wide range of social phenomena is governed by sets of norms that prescribe appropriate behaviors and sanction inappropriate conduct. Most populations have institutional rules which promote sharing or fair transactions, albeit these vary according to the degree to which they are stressed and the boundaries within which they apply (see Barth [2]). Authors such as Henrich & Ensminger [16] or Henrich *et al.* [17] have studied the influence that social context has on the behavior of individuals. Concretely, they conduct an exhaustive analysis of this behavior in what they call "small societies" and compare behavior among different cultures.

The aim of this paper is to study concepts of **fairness** or equity in a specific ethnic group: **non-integrated Spanish gypsies**. It should be noted that our objective is to analyze the above concepts solely within and among

gypsies.[4] Two reasons motivate this paper: (*i*) Spanish gypsies are a highly marginalized, yet very cohesive, sub-group embedded in an advanced western society and tend to be characterized in a very contradictory manner. That is, non-gypsy citizens have a very negative concept about this community[5] for reasons such as their involvement in drug trafficking or gypsies' tendency to live on the fringes of mainstream society or to be asocial. But not everything that gypsies do is deemed negative. Indeed, there are some "positive" characteristics associated with them, namely their artistic skills such as flamenco dancing or their extraordinarily strong family ties and group solidarity (see Martin & Gamella [19]). (*ii*) This paper expands upon the growing body of cross-cultural experimental research in western countries using the CORE[6] package in Spain; a developed country which is a member of both the EU and the OECD. This type of experiment has typically (although not exclusively) been conducted in underdeveloped countries of Asia, South-America or Africa. Here we analyze a "small community" living within the context of a European country.

In sum, this paper examines the Strategy Method Ultimatum Game played among gypsies in Vallecas (Madrid). Our aim is to study two measurements of behavior: **the sense of fairness (or altruism) and the fear of direct pun-**

[4] We only compare intra-gyspy behavior in an attempt to avoid such problems as racism, apprehension or feelings of unsafety and mistrust that may arise when the game is played against another ethnic group and can influence offers (see Ferraro & Cummings [11]). Although we can only conclude that our specific population plays the game in this way, note that results from this experiment could be generalized to other populations which share the same features as ours.

[5] Indeed, confrontations between gypsies and non-gypsies are not uncommon (see Gamella [12]). *The Spanish Racial Discrimination Report* (see Díez–Nicolás [6]) shows that a large percentage of ethnic Spaniards disapprove of gypsies (nearly 90%).

[6] Additional information and the whole CORE protocol may be consulted at: http://webuser.bus.umich.edu/henrich/gameproject.htm

ishment (sanctions for inappropriate or unfair behaviors). In section 2 we show some features of the population. In Section 3 the experimental design and procedures are described, while results are shown in Section 4. Conclusions are drawn in Section 6.

Study population: Gypsies living in slums outside Madrid

Gypsies[7] are an extremely diverse minority in Europe, with multiple subgroups based on linguistic, historical and occupational distinctions. The history of the Roma is as varied as the countries to which they have migrated. Nonetheless, *marginalization and discrimination* have been and continue to be common features of this population. Gypsies usually live in overcrowded households located in isolated neighborhoods with high rates of crime and drug use and with limited access to public services such as waste collection, gas, electricity and water. Large distances separate gypsies and non-gypsies or "gadje" and gypsies consider themselves to be very different from the gadje. This distance breeds mistrust and reinforces negative stereotypes.

Education is also a problem: school-age children suffer from increasingly high dropout rates while the percentage of gypsies in secondary and post-secondary education is much lower than that of non-Roma citizens. Unemployment rates among the gypsy population are often exceptionally high (100% unemployment is not uncommon in some Roma settlements). In terms of demographic trends, the Roma have a higher population growth than other groups, meaning that

[7] This section is a summary of several papers devoted to gypsies. Specifically we used Martin & Gamella [19], Gamella [12], Ringold *et al.* [22] and Gay Blasco [13].

this community is younger than other groups.

Approximately 600,000 gypsies currently live in Spain (half of them in the region of Andalusia) and have settled down in permanent communities. Although poverty levels and social discrimination are lower for Spanish gypsies than for Roma communities in Central and Eastern Europe, gypsy households and communities in Spain are still characterized by their lack of running water or the absence of police protection.

Gypsies do not have written rules. Instead, their entire set of social norms is transmitted by observation and imitation (see Lancy [18]) or can be transmitted orally from generation to generation. Thus the older members play a key role in the society and are looked up to by the whole population who hold their experience and knowledge in high esteem. The older members hold authority over the younger members of the society as do men over women. Three basic social rules govern gypsy society:

- **solidarity among gypsies**. This can be classified into two main obligations: hospitality and aiding others; including giving financial support to other gypsies.
- freedom as a natural condition of gypsy life.
- symbolism as a representative feature of gypsy culture. This includes flamenco, which is considered to be an expression of gypsy lifestyle.

As in the rest of Europe, literacy and school attendance rates are very low among the Roma population. A very small percentage of the Roma finish basic

education in Spain. The job market for Roma families is very different from that of the rest of population. Jobs are low paid and few gypsies hold full-time, salaried employment. Around 50-80% of gypsies are peddlers, collect scrap or perform menial jobs.

The average Roma family is made up of 5.4 members compared to 3.7 members of a non-Roma Spanish family. The points above are applicable to the entire population of gypsies living in Spain.

Let us now explore our subject pool[8]. The entire experiment was conducted in July 2004 at the "Asociación Barró" School for Adult Education. Run by nuns, the main goal of this school is to teach illiterate adults to read and write. The school is located in Vallecas, one of the poorest districts on the outskirts of Madrid, Spain. Although most of the students at "Asociación Barró" are originally from Santa Catalina (a slum outside Madrid), many of them have benefitted from subsidized housing provided by the autonomous government of Madrid and have moved out of the area. Others, however, have remained in the Santa Catalina settlement or are squatters.

Although gypsy children generally receive schooling, absenteeism and dropout rates are very high[9]. These alarming figures can be explained by the phenomenon of "exclusion" (marginalization) occurring in the south-east area of Madrid where the Asociación Barró is located. More than 50% of the adult population is illiterate. Many of them, especially women and older members,

[8] This part includes an interview conducted with Blanca González, one of the volunteers who works at the Barró Association.

[9] The Plan against Social Exclusion in Madrid reports rates of absenteeism to be as high as 48.7% during the period of compulsory education.

do not have stable employment and must do unskilled work such as selling flowers, fruits and vegetables or clothes in the marketplace or collecting and selling scrap metal, etc... Although gypsies have become the target of a public program to improve their precarious situation, their relationship with the State is a complex one. While in some cases they will accept public protection such as housing (aid that they become very dependent upon), in most cases they prefer to have nothing to do with public authorities, especially the police.

From the CORE questionnaire we selected the 40 most relevant items for urban populations in Western countries. Table 1a and 1b summarize the main findings for the 38 subjects who participated in the experiment (n is the number of answers). Table 1a shows the percentage of the population having the selected attribute, while the average of some numerical attributes is analyzed in Table 1b.

As shown, 73% of the population is married and 86% has children. The mean number of children per family is close to 3, even though the mean age of the population is very low (28.79). 93% of the population considers that they have some level of education. It is interesting to note that gypsies consider learning to read and write an indicator of having achieved a certain educational level. On the whole, the population is very poor. Only 1 out of 38 subjects is a homeowner and none owns property.

Cooperative institutions. 15% of the population does volunteer work in an association and dedicates about 1 hour per week on average to this activity. 24% are club members and spend around 5 hours per week at their club.

Networking. We observed that the mean number of guests that come for lunch in gypsy homes is higher than 5. This finding, together with the fact that the mean number of siblings is 6 (a very high number compared to the overall Spanish mean of 2.7), may be of great help in understanding the "sharing" behavior shown by the players.

Table 1.a: Population Features I

Attribute	%	n	Attribute	%	n
female	68	38	married	73	37
some level of education	93	37	lives with partner	67	33
part-time job	64	11	has children	86	35
gypsy boss	0	4	was born in Spain	100	38
homeowner	3	34	was born in Madrid	63	38
does not own a watch	64	38	was born in a rural village	18	33
no satellite television	87	38	head of the family	54	35
does not own a radio	24	38	the family eats together	16	38
does not own a car	70	38	houses with guests	54	37
property owner	0	38	thinks they live in a safe home	74	38
unemployed	83	23	club member	24	34
religious	75	36	volunteer worker	15	33
goes to church	59	29	distrustful of people	56	36
goes to school	65	38	inequity averse	49	37

Table 1.b: Population Features II

Attribute	Mean	n	Attribute	Mean	n
age	28.79	37	number of children	2.57	30
school attend./years	3.6	25	number of siblings	6	38
hours worked/week	24.6	10	position among siblings	3.84	38
gypsy colleg./job	15.3	3	people living in a house	4.76	38
church attend. days/month	21.61	18	guests for lunch everyday	5.73	23

Experimental design & procedures

The research was conducted following part of the CORE package guidelines from the Cross-Cultural Analysis (see Henrich and Ensminger [15]). Specifically we used the Strategy Method Ultimatum Game[10] (SMUG hereafter)[11] as well as an extensive survey included in that package. Observe that we obtain two different measures of individual behavior: from player B's responses (recipients) we obtain if they would accept or reject each of all the possible offers made by player A (proposer). This value allows us to determine how willing individuals are to punish others' unfairness at a cost to themselves. On the other hand,

[10] The SMUG is basically identical to standard Ultimatum Game for proposers. The main variation is related to responders who are invited to accept/reject offers in advance. Using a 10-euro pie, we asked subjects the following questions:
- Would you accept the division of the money if the proposer offers you 10 Euros?
- Would you accept the division of the money if the proposer offers you 9 Euros?
And so on untill the last one: Would you accept the division of the money if the proposer offers you 0 Euros?

[11] Guth, Huck and Muller [14] show that results from the SMUG are significantly different from the results of the standard UG (although this comparison is not straightforward), so the results obtained in this paper may be considered from this point of view.

from player A's behavior we can obtain a combination of preferences for fairness or fear of direct punishment (strategic behavior). From post-game interviews we can conjecture whether or not player A's response is given out of a pure sense of fairness.

As shown in Table 1, the survey explores several individual attributes such as personal features, labor issues, social integration and so on. The survey includes several questions related to the game that players are asked to answer after playing. Specifically:

- Proposers were asked to answer the following questions: (#1) Did the ultimatum game remind you of anything related to real life? (#2) Why did you give that amount? Why not less or more? (#3) Do you think most people would have given less?.

- Recipients were also asked about the previous item (#1) and: (#2) How would you have felt if you had received an offer of 0€ from Player 1?; (#3) How would you have felt if you had received an offer of 10€?.

In order to gain further knowledge about this particular population we enlarged upon the standard procedure. Once the subjects had answered questions 1 to 3 we added another item: they were asked to play the opposite role (hypothetically). The proposers were then asked about acceptation rates and the recipients were asked about divisions.

Participants (a total of 38) were students at "Asociación Barró" (an adult school located in the Vallecas neighborhood of Madrid, see previous section) who

came voluntarily the day of the experiment. They were invited to "participate in an investigation in which they could earn some money". The experiment was conducted by the 3 authors[12] plus 6 volunteers who helped to do the survey[13] as follows:

- First, all the subjects received the instructions orally in one room (recall that the subjects did not know how to read or write). The instructions stated that the money did not belong to the experimenters, so it was very clear that the game was not a question of gypsies *vs.* experimenters, but gypsies *vs.* gypsies. At this time each subject also received the 3€ show-up fee and was assigned an identification number.

- Second, the subjects were randomly asked one by one to go to another room where PBG conducted personal interviews which included the game (this implies that the experiment was single blind). Real money was placed on the table to explain each case to both recipients and proposers. The examples were repeated until they were fully understood by the subjects.

- Third, subjects went to another room where AD and RCR, with the help of the 6 volunteers, conducted the full CORE survey. That is, when subjects finished the SMUG, they went to a different room to continue with the questionnaire[14]. By doing so, the participants who had finished the game

[12] Pablo Brañas-Garza (PBG) read the instructions and conducted the SMUG individual by individual, while Ramón Cobo-Reyes (RCR) and Almudena Dominguez (AD) coordinated the whole survey with the help of the 6 volunteer nuns.

[13] Note that the 6 volunteers did not know anything about the game and only helped us with the questionnaire. They were in a different room while the SMUG was conducted in order to ensure the participants' anonimity with respect to the nuns.

[14] The survey asked the individuals (hypothetically) about inequity aversion.For purposes

could not talk to the individuals who were waiting to play.

- Lastly, PBG did the matching and then each subject received the money privately in a sealed envelope.

Given that we were more interested in obtaining data from the recipients rather than the proposers, we decided to use a simple mechanism: all the subjects with an identification number that was a multiple of 3 would be proposers, while the remaining players would be recipients. To facilitate the matching process, we used the following rules: the two numbers[15] following each multiple of 3 would be the recipients of the previous multiple. Hence subjects #4 and #5 were the recipients of #3; subjects #7 and #8 were the recipients of #6 and so on). However for the proposer to earn the money, his only relevant partner was the following subject (i.e. #4 for #3, #16 for #15, etc.). A complete transcription of the instructions and procedures are available in both Spanish (original) and English (professional translation) at www.ugr.es/~pbg/material/intro.htm. The instructions show that deception does not constitute a problem given that we never told participants that they would be matched one-to-one with only one person in the experiment. The experiment lasted two hours. The subjects' average and modal earnings were 5€ plus 3€ for the show-up fee. This amount of money is approximately equal to the daily salary they earn selling scrap metal.

of brevity, the test about inequity aversion is not included in the final version of this paper. Cobo-Reyes and Jimenez [9] explore these results in depth.

[15] Obviously, in the case of subject number 2 there is only one number which is paired with 1. Of course, these devices were not made public. We also used subject 26 as a proposer to introduce some "noise" with the aim of making it more difficult for participants to guess who their partners were.

Results

Recall that the players played two different roles. The results of the regular task (i.e. the standard SMUG) are summarized in column 2 of Tables 2 and 3. In column 4 of Tables 2 and 3 we show the results of the role reversal in which individuals switch their roles (but only in a hypothetical way). That is, former proposers play the game as recipients and former recipients play the role of proposers. Finally we analyze if both samples arise from the same population. The results after merging the samples are shown in Column 6 of Tables 2 and 3.

Column 2 in Table 2 shows the divisions proposed by the 14 gypsy subjects who played as player A in the SMUG.

The result is clear: proposers do not take advantage of their position and only one of them proposes an unfair division.

Result 1: The percentage of subjects offering an equal split is overwhelming (93%).

Why did they choose the equal split? Recall that we asked the subjects some questions during the experiment. Item #2 inquired as to why subjects made such a division. The only subject who did not choose the equal split did not give an answer. The remaining subjects gave such explanations as *fairness* (11 out of 14 subjects) and *strategic behavior*[16] (2 individuals). Thus, we may conjecture that the division was not caused by fear of rejection.

[16] One of them admitted: "Everybody here will accept an equal split. Using another more advantageous division would be very risky".

In contrast, item #1 asked subjects if they associated their role in the SMUG with any real situation: 4 of them considered their role to be unfair; 3 mentioned sharing rules, whereas the remaining subjects made reference to gambling (3), TV programs (1) or business dealings (3).

Table 2: Proposed Divisions

	Original		Role-Rev.		Both	
Divisions	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.
10.0	0	0	0	0	0	0
9.1	0	0	0	0	0	0
8.2	0	0	0	0	0	0
7.3	1	0.07	0	0	1	.03
6.4	0	0	0	0	0	0
5.5	13	.93	24	1	37	.97
4.6	0	0	0	0	0	0
3.7	0	0	0	0	0	0
2.8	0	0	0	0	0	0
1.9	0	0	0	0	0	0
0.10	0	0	0	0	0	0
Total	14	1	24	1	38	1

Column 2 in Table 3 shows all the offers accepted by the 24 gypsies who

played as recipients. Note that $o \in [0, 10]$ means that the subject accepted offers of 0€, 1€, ..., 10€ and $o \in [4, 6]$ means that they only accepted offers of 4€, 5€ and 6€. Note that o denotes the recipients' acceptance.

Table 3: Accepted Offers

	Original		Role-Rev.		Both	
Intervals	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.
$o \in [0, 10]$	6	0.25	5	0.36	11	0.29
$o \in [1, 10]$	2	0.08	3	0.21	5	0.13
$o \in [2, 10]$	7	0.29	0	0	7	0.18
$o \in [3, 10]$	3	0.13	2	0.14	5	0.13
$o \in [4, 10]$	4	0.17	1	0.07	5	0.13
$o \in [5, 10]$	0	0	1	0.07	1	0.03
Others						
$o \in [4, 6]$	1	0.04	0	0	1	0.03
$o \in [2, 8]$	0	0	1	0.07	1	0.03
$o = [5, 5]$	1	0.04	1	0.07	2	0.05
Total	24	1	14	1	38	1

It is striking to note that about 30% of the population accepted any amount greater than 1€, while it is even more surprising that 25% of the subjects accepted the zero offer, the Nash equilibrium.

The explanations that these 6 subjects gave regarding their behavior are very interesting indeed. They said that they accepted a zero offer because if the proposer did not share, it was because he or she needed the money. They also remarked that it was better for the proposer to keep the entire amount of money than to lose it all!

Result 2: Driven by solidarity and utilitarian criteria, 25% of the subjects accepted the zero offer.

Let us highlight some of the answers given by subjects during the experiments. Item #1: 10 subjects (out of 24) did not associate their role in the SMUG with any real situation; 4 considered their role to be unfair; 3 mentioned sharing rules whereas the remaining subjects made references to gambling (3), TV programs (1) or business dealings (3).

Thirteen (out of 24) subjects admitted that they would not be happy with the zero offer (item #2), while only one considered such an offer to be an offensive division. In contrast, only 7 subjects stated that they would be happy if the proposers gave them the whole endowment (item #3) and 10 of them said that they *did not like* this advantageous division (however only two of them did not accept divisions heavily in their favor).

As we mentioned above, subjects were asked to hypothetically play the opposite role. Column 4 in Table 2 shows the offers proposed by former recipients, while the same column in Table 3 shows the acceptance rates for former proposers. We have used non-parametric tests to check if both samples arise from the same population. Fortunately, the answer is yes for both the divi-

sions [Mann-Whitney ($z = 1.30, p = 0.73$) and Kolmogorov-Smirnov tests ($z = 0.21, p = 1$) do not reject] and the acceptance values [neither the Mann-Whitney ($z = -0.77, p = 0.46$) nor the Kolmogorov-Smirnov tests ($z = 0.84, p = 0.47$) reject]. Given that the data are drawn from the same population, we are able to merge samples. Column 6 in both Table 2 and Table 3 respectively shows the population values for divisions and acceptance rates.

While the percentage of subjects offering an equal split is even larger than in the original case, the most striking result is that *after merging samples, zero became the modal* of the acceptance rate! Hence we can conclude that fairness criteria is not symmetrically distributed: while there is a large percentage of subjects accepting very unfair, even zero offers, the percentage of subjects proposing the equal split is overwhelming. To summarize:

Result 3 (main): The equal split is not solely the modal proposal, but is used by 97% of the subjects. In contrast, gypsies are willing to accept completely unfair offers including the minimum modal offer of zero.

The former means that subjects are completely fair when they are asked to share some amount of money. However, the latter illustrates that they are also willing to accept completely unfair divisions!

Now we study determinants of fairness using a linear regression. The minimum value (MV hereafter) of each individual's accepted offer is used as a dependent variable. Thus, MV is the minimum value from the whole set of accepted offers[17]. We use the previous socioeconomic items obtained with the survey as

[17] Observe that if individuals give us more than a switching point (from accepting to re-

independent variables (see Table 1).

To control real from hypothetical data we introduce a dummy variable which takes a value of 1 **if subjects hypothetically decide the proposed distribution**. Recall that nearly 100% of the subjects chose the equal split so we cannot estimate the effect of the variables reported in Table 1 on the proposed divisions.

Table 4 shows these estimates: Column (1) shows the estimation with the whole set of variables, whereas column (2) repeats the estimation with only the significant variables ($*$ means significant for $\alpha = 1\%$).

The results are summarized as follows:

- Educational level, economic variables (home ownership, job conditions, etc.), number of siblings, social integration (trust, volunteer work) do not explain the minimum value.
- On the other hand, church attendance, number of people living in a house, houses with guests, number of guests invited for lunch and club membership have a significant effect on the minimum accepted offer.
- The dummy variable which labels role reversal does not have a significant effect.

jecting) it would be problematic; in fact, we may not proceed as we did with that "special" observations. A larger number of switching points would be explained by both confussion (see first part of section) and prominence.

Table 4: OLS regressions

Variables	Regression 1	Regression 2
constant	$3.36(2.89)^*$	$2.05(1.21)^*$
school attendance	$-0.53(0.70)$	
unemployed	$1.90(1.37)$	
church attendance	$1.46(0.53)^*$	$1.13(0.49)^*$
number of siblings	$-0.03(0.08)$	
people living in a house	$-0.47(0.18)^*$	$-0.33(0.17)^*$
the family eats together	$-0.96(1.03)$	
houses with guests	$-1.21(0.54)^*$	$-1.51(0.52)^*$
number of guests	$-0.18(0.08)^*$	$-0.12(0.06)^*$
think they live in a safe home	$0.40(0.57)$	
clubmember	$2.80(0.60)^*$	$2.15(0.57)^*$
volunteer worker	$-0.64(0.71)$	
trustful of people	$-0.03(0.68)$	
gender	$0.32(0.49)$	
age	$-0.06(0.04)$	
dummy	$-0.45(0.63)$	$-0.55(0.72)$
R^2	0.88	0.67

$n = 23$. Standard errors in brackets. * significant for $\alpha = 1\%$

Our results show that individuals who share their lunch with guests are ready to accept lower amounts of money. In the same way, the number of guests

invited for lunch and the number of people living in a house diminishes MV. However, subjects who are members of a club are not willing to accept small offers. Church attendance also has a positive and significant effect on MV. A possible explanation for this behavior is that individuals who invite guests for lunch and subjects who live in houses with a large number of people have a greater sense of *solidarity*. On the other hand, individuals who belong to a club have a stricter sense of *fairness*, so they are not going to accept an amount of money which they consider to be unfair. In the following section we study both ideas of fairness and solidarity.

Discussion and concluding remarks

Before discussing subjects' behavior in greater detail, we must note that confusion does not constitute a problem in our results. Bahry and Wilson [1] hypothesize that "atypical intervals of rejection" may be due to fairness or confusion. Following their criteria, the number of possible confused subjects is very low (2 recipients + 2 role-reversal recipients out of 38 individuals) in our sample. Even for these subjects, the responses on the questionnaire given at the end of the experiment seem to support the claim that they were not confused, but were acting on a desire to be fair.

We observed two contradictory behaviors in the two different decisions that the subjects took. In the first decision, the subjects proposed an equal division of the money. The reason for this is that they are morally obliged to distribute

the money in a **fair** manner[18]. This sense of fairness could be due to the fact that they have a large number of siblings, that they invite many guests for lunch everyday and that many of them do volunteer work (see Table 1 for an overview of the population features).

In the second case, subjects even accept zero offers. Therefore, individual decisions are not driven by the same sense of fairness. The arguments given by the experimental subjects may serve to explain this behavior. Statements such as "if he needs the money..." or "he is more needy than me" lead us to the following conjecture: *subjects will accept even the most disadvantageous distribution because they believe that if another subject does not respect the "sharing rule" it is because he is more needy.* Hence, as our survey pointed out, they do not feel offended, but just think that if the proposer offers zero it is because he needs the money and should therefore accept it! Arguments such as solidarity also come into play. Martin & Gamella [19] reinforce the hypothesis of solidarity for this population with the notion that the high rate of consanguinity among Spanish gypsies may have important social consequences; one of them being that it increases the solidarity of gypsies along family lines. Brañas-Garza [5] shows that solidarity will be greater in cases where the counterpart is more needy. Note that when subjects consider that their partners really need the money, the only way to ensure that the other individual will receive the payment is by choosing the interval [0,10]. In this case, the subject will get the amount the other does not need. In the ethnic group studied here, solidarity is related

[18] The idea of fairness has been analyzed by authors such as Fehr and Schmidt [10] or Bolton and Ockenfels [4]

to the gypsies' social norms. As we explained above, solidarity is one of the main features of the value system of this population, particularly helping other gypsies financially. Hence, individuals are socially obligated not to punish other gypsies. Our results show that this social norm is, in fact, observed by these actors, thus explaining the two contradictory behaviors shown by the players[19].

Lastly, our analysis shows that variables related to education, economic standards (home ownership, job conditions, etc.), religiosity, siblings, social integration (trust, volunteer work) do not explain MV. We also find that both the number of people living in a house and guests for lunch play a negative and significant role on the minimum amount of money accepted. However, other variables such as club membership or church attendance have a positive effect on MV.

To sum up, individuals will demonstrate fair behavior when deciding how to divide the money. Nonetheless, when subjects must decide about the minimum amount of money they will accept, this behavior will change depending on their sense of solidarity and their desire to maximize their social welfare.

Given the diversity of gypsy communities and their differentiation in multiple subgroups, we cannot affirm that these results are generalizable to all Roma across Europe. However, in Spain, gypsy patterns of behavior are very similar and the living and social conditions of our specific population are not very

[19] As well as solidarity, we may also suppose that lexicographic preferences play a relevant role in individuals' behavior, i.e., individuals will accept even unfair divisions because they want to *maximize their social welfare regardless of how the money is actually distributed* (with this strategy they minimize the probability of both players obtaining zero). However, as the referee pointed out, this argument is not wholly true because, under this kind of preferences, proposers should offer the entire amount of money to the responder.

different from those of other Spanish gypsies. Hence, it is plausible to expect similar behavior among the Spanish gypsy population.

References

[1] Bahry, D. L. and Wilson, R. K. Confusion or fairness in the Field? Rejections in the Ultimatum game under the Strategy method. *Journal of Economic Behavior & Organization forthcoming.*

[2] Barth, F. (1969) Ethnic groups and boundaries: the social organization of culture difference. *Boston: Little*, Brown.

[3] Bateson, D., and Shaw L. (1991) Evidence of altruism: Toward a Pluralism of Prosocial Motives. *Psychological Inquiry* **2**; 107-122.

[4] Bolton G.E. and Ockenfels A. (2000) ERC: A theory of Equity, Reciprocity and Competition. *American Economic Review*, **90**: 166-193.

[5] Brañas-Garza, P. (forthcoming) Poverty in Dictator Games: Awakening Solidarity, *Journal of Economic Behavior & Organization.*

[6] Díez–Nicolás, J. (1998) Informe ASEP, *Ministerio de Trabajo y Asuntos Sociales (IMSERSO)*: Madrid.

[7] Camerer C. (2002) *Behavioral Game Theory: experiments on Strategic Interaction.* Princeton University Press.

[8] Charness, G. and Rabin, M. (2002) Understanding social preferences with simple tests. *Quarterly Journal of Economics* **117**: 817-869.

[9] Cobo–Reyes, R. and Jimenez, N. (2006) Inequity aversion among gypsies: a hypothetical investigation, *mimeo.*

[10] Fehr, E. and Schmidt, K. M. (1999) A Theory of Fairness, Competition and Cooperation. *The Quarterly Journal of Economics* **114**, 817-868.

[11] Ferraro, P. and Cummings, R. (2005) Experimental approaches to understanding conflict over natural resources. *Water Policy Working Paper* **016**.

[12] Gamella, J. (2002) Exclusion social y conflicto étnico en Andalucía. *Gazeta de antropología* **18**.

[13] Gay Blasco, P. (1999) Gitanos of Madrid. *Oxford, Berg.*

[14] Guth, W. Huck, S. and Muller, W. (2001) The relevance of equal splits in ultimatum games. *Games and Economic Behavior* **37**: 161-169.

[15] Henrich J. & Esminger, J. (2002-2005) The Roots of Human sociality: an ethno-experimental exploration of the foundation of Economic Norms. *Project of the California Institute of Technology, division of the humanities and social sciences.*

[16] Henrich J. (2000) Does Culture matters in Economics Behaviors: Ultimatum Game Bargaining among Machiguenga. *American Economic Review* **90**: 973-980.

[17] Henrich J., Boyd, R. Bowles, S. Camerer, C. Gintis, H. McElreath, R and Fehr, E. (2001) In search of Homo economicus: Experiments in 15 small-scale Societies. *American Economic Review* **91**: 73-79.

[18] Lancy, D. (1996) *Playing on mother ground: cultural routines for children's development.* London: The Guildford Press.

[19] Martin, E. & Gamella, J. (2005) Marriage practices and ethnic differentiation: the case of Spanish gypsies (1870-2000). *The history of the family* **10**: 45-63.

[20] Rabin, M. (1993) Incorporating fairness into game theory. *American Economic Review* **83**: 1281-1302.

[21] Rabin, M. (1998) Psychology and Economics. *Journal of Economics Literature* **XXXVI**: 11-46.

[22] Ringold, D. Orenstein, M & Wilkens, E. (2000) Roma in an expanding Europe: breaking the poverty cycle. *World Bank Studies*.

Inequality aversion among gypsies: a field investigation

Introduction

Gypsies are one of the highest minorities in Spain, approximately 600 thousand (around 1.5% of the total Spanish population) and its life has been marked by persecution, discrimination and social exclusion. Although gypsies have achieved full status as citizens and there have been improvements in their access to education, housing and so on, they still suffer from segregation and marginalization specially in the slums constructed, often by public initiative, on the outskirts of many Spanish cities (see Gay Blasco [10]).

Gypsies appear in the top of most negative indices such as lack of vaccination, accident rate or prison but they do not appear in positive indices such as economic, educative or political development.

Research about economic behavior of Spanish gypsies is still reduced. Although a large number of papers such as Gamella [8], Gay Blasco [10] and Sanchez Ortega [21] among others have described gypsies' history, social context or patterns of behavior, as far we know, only Brañas-Garza, Cobo-Reyes and Domínguez [2] (BCD hereafter) have studied this population using economic methods. Specifically, BCD analyze concepts of fairness and solidarity among Spanish gypsies using a Strategy Method Ultimatum Game and find an unexpected high level of solidarity among them.

This paper intends to enlarge BCD previous research analyzing other possi-

ble factors explaining pro-social behavior, in particular we focus on *inequality aversion* and its determinants.

A large body of experiments has shown that people do not choose systematically in order to maximize their own material payoffs (see Henrich [13] and Henrich *et al.* [14]). Recent literature on other regarding preferences tries to explain individuals motivations for this behavior. Among these arguments, inequality aversion appears as a key factor. Inequality aversion is defined as the extent to which an individual prefers a more equal distribution of the money. Ferh & Schmidt [5] or Bolton & Ockenfels [1], propose models which introduces inequality aversion as an explaining factor of individuals' behavior.

Experimental evidence is not conclusive about individual's inequality aversion: while authors as Charness & Grosskopf [3] shows that inequality aversion does not matter (even when there is an advantage distribution for players' partners), Loewenstein, Thompson and Bazerman [19] have found evidence that subjects exhibit a strong and robust preferences against disadvantageous inequality.

The aim of this paper is to explore inequality aversion among a specific population: Spanish gypsies. This paper also enlarges this research with the analysis of the main items from the CORE[20] questionnaire as determinants of inequality aversion.

To perform the above investigation we conducted an economic experiment

[20] CORE survey is an international project to analyze anthropology foundations for human behavior. This survey contains three different experiments (ultimatum game, dictator game and punishment game) plus an extensive questionnaire. The whole CORE protocol may be consulted at http://webuser.bus.umich.edu/henrich/gameproject.htm .

plus an extensive survey among gypsies belonging to the school for adults "El Barro", placed in Vallecas, Madrid. The sample consisted of 38 subjects, both females and males who come voluntarily to the experimental session[21]. All the subjects were students from this school which means that they were illiterate and with very low wealth. We used the CORE survey to explore demographic attitudes and social capital issues. The survey comprises a large number of questions regarding subjects own education, religiosity, family size, social integration, social capital and so on. To elicit individual inequality aversion we used a modified version of the device proposed by Kroll & Davidovitz [15].

Results show that 50% of the population are inequality averse. Results also indicate that inequality aversion is positively related to femininity, number of children, churchgoing, family responsibility, family size, social integration and other social capital indicators; and negatively to age, education, self-esteem and trust. Surprisingly, the current level of income does not affect.

The paper is structured as follows. Next section explains the mechanism proposed by Kroll & Davidovitz [15] to elicit individual inequality aversion. Section 3 analyzes the sample, the experimental protocol and the survey. The fourth shows results and section five concludes.

[21] Recall that the experiment was conducted exclusively among gypsies, i.e., the whole sample was compounded of gypsies, so we did not study the behavior of gypsies facing non-gypsies. This paper is only a first approximation to gypsies' economic behavior and we were interested in analyze first the pure level of inequality aversion without problems of racism or mistrust which could appear when individuals play the game against other ethnic groups (see Ferraro & Cummings [6]). Hence, the study of inequality aversion when gypsies play the game vs. non-gypsies is an open question to analyze.

Kroll & Davidovitz (2003)

Kroll & Davidovitz [15] (hereafter KD), propose an straight and simple method to explore individual inequality aversion. The idea is that subjects facing a decision problem show, by themselves, if they are or not inequality averse.

In KD individuals are asked to choose between two different lotteries featured by: *a*) identical risk (both lotteries share the level of risk) but *b*) heterogeneous distribution (they differ in the way the reward is distributed among the whole population).

Kroll & Davidovitz imposed the same risk level to both procedures to eliminate risk aversion[22] as a possible explanation for inequality aversion. The later is easy to understand with an example.

> **Example**: *Imagine the life in a small village in the jungle where the maintenance of individuals depends completely on the total bag they hunt. Possibly, a subject prefers an egalitarian distribution of the food not because he is inequality averse, but because he does not want to take the risk of hunting not enough animals.*

The essence of the KD method is as follows. The individuals' payoff depends on the number shown by the dice[23] thrown by the experimenter. Before the

[22] Risk aversion is defined as the desire to avoid uncertainty (Deardorff [4]). In the theory of expected utility maximization, a risk averter is defined as an individual with a concave utility function (Friedman & Savage [7]).

[23] For instance, if the number indicated on the dice is 1, individuals obtain 1 Euro; if the number is 2, individuals get 2 Euros, and so on.

In the original mechanism, Kroll & Davidovitz defined the payoffs different from what is here explained. They assigned the value of "winning" when the dice showed an even number and the value "losing" when the dice showed an odd number. The payoffs associated to each group of number varied across the 3 treatments. The main difference with the device of Kroll

experimenter throws the dice, subjects are offered two possibilities:

Alternative 1 (common): the experimenter throws the dice once for the whole population, so all individuals would receive the same payoff (depending on the number shown by the dice).

Alternative 2 (individual): the experimenter throws the dice once for each particular individual, therefore a subject would receive his reward according to the number indicated on *his* dice.

Note that the *probability of obtaining a specific amount of money* (the risk of the lottery) *is the same in both methods* (1/6 for each of the six different payoffs). Thus the only difference between these two possibilities is the distribution of the money.

Applying alternative 1 all individuals obtain the same payoff, whereas in alternative 2 each participant gets his own payoff (which, particularly, could be the same for all players). Hence, we may use the next two definitions:

Definition 1 (inequality averse) *Subjects who choose alternative 1, given that they prefer all individuals to obtain the same amount of money.*

Definition 2 (inequality lover) *Subjects who choose alternative 2 given that they prefer each individual to obtain his own amount of money.*

& Davidovitz is that all the even numbers had the same payoff and the same holds for all the odd numbers, while in our procedure each number of the dice is associated with different payoffs. But the essence of the mechanism (to keep the risk level constant among alternatives) remains in our procedure.

Note that the above definitions imply that subjects are just either averse or lover.

Experimental design, procedures and rewards

Design

We conducted this research following part of the CORE package included in the Cross–Cultural Analysis Second phase (see Henrich and Ensminger [12]). We carried out the extensive survey, included in that package, plus two different experiments: the Strategic Method Ultimatum Game (SMUG) and the Inequality Aversion Test (IAT) described above. SMUG was motivated with monetary rewards while IAT was conducted hypothetically. Whereas BCD explores the SMUG, this work focus on the inequality aversion test[24] .

As in KD, our subjects were invited to choose between a collective (but uncertain) prize and a personal (but uncertain) one.

We will show later (see table 1, page 85) the results and the main findings of the survey which explores several individual attributes such us personal features, labour issues, social integration and so on.

Rewards

The IAT mechanism -which separates inequality aversion from risk aversion- seems very intuitive and easy to understand, but the way of implementing the

[24] For a more detailed explanation of the whole experiment, including SMUG, see Brañas-Garza et al. [2].

"winning" alternative is not at all obvious. The problem is that there are many players choosing between the two alternatives explained before, hence in order to decide subjects' final payoff we must implement only one of these alternatives. The question is how to decide which alternative (1 or 2) will be executed. Some options are:

Decision rule 1 (KD): common or individual dice would be determined by the choice of the majority of the group.

The weakness of this method relies on the following fact. If subjects know ex-ante that this would be the decision rule, the decisiveness ex-ante of each individual is very small [25], therefore their decision will have a very low impact on others income. In the case that subjects do not know the decision rule before making their choice, this situation may generate deception.

Decision rule 2 (random): the alternative would be executed according to a decision randomly chosen from the whole group of individuals.

However, this procedure would imply similar disadvantageous features as the rule used by Kroll & Davidovitz. Firstly, the decisiveness ex ante of a subject is only $\frac{1}{n}$, where n is the total number of individuals. In addition, this system is

[25] For a more detailed explanation about decisiveness, see Laurelle & Valenciano [17]. They defined decisiveness ex-ante as the probability that a voter is successful and his vote is critical for it. Individual i is said to have been successful if the final decision coincides with voter i´s vote. In particular, assuming that the distribution of vote configuration, S , is uniform, that is $p(S) = \frac{1}{2^n}$, the decisiveness ex-ante of any individual i in the majority rule is $\frac{\binom{n-1}{\lfloor \frac{n}{2} \rfloor}}{2^{n-1}}$. For instance, if $n = 38$ i's decisiveness is 1.42×10^{-11}.

too complicated in the sense that payoffs are a composed lottery[26], hence the execution of subjects' decision depends too much on randomness.

Decision rule 3: consider the decision rule of the last paragraph, i.e., the alternative implemented is only decided according to the preferences of one individual of the group. The difference is that this individual is not randomly chosen but chosen from an ordered list of the whole group. Repeat this procedure with the remainder subjects of the list. Therefore, in each repetition one different subject is the "dictator" in the decision rule. This method avoids deception and also all individuals are decisive in one repetition.

However, one of the inconveniences of this procedure would be the waste of time (even if only one individual decides the alternative which implies throwing one dice for each individual, the length of throwing a dice $2n-1$ times would be too long). Moreover, from the point of view of the aggregate payoffs the decision of one individual would not make a big change in others income.

Taking into account this analysis of the difficulties to implement payoffs and given that subjects were already paid a show-up fee and they also were paid for the SMUG experiment, we considered that not to pay the subjects for the IAT would not make an important difference with respect to the incentives. Hence, we conducted the IAT in an **hypothetical way**. As the SMUG was conducted before the IAT, subjects were already involved in an economic setting and they

[26] A lottery for the decision of the alternative of throwing the dice, and a lottery for the final payoff according to the number shown on the dice.

have incentives to perform the task seriously and therefore, the results obtained seem to be a good approach of their preferences concerning inequality.

Procedures

The whole experimental session was conducted in July 2004 in the School for Adults "El Barro" in Vallecas. This school is driven by nuns with the target of teaching illiteracy gypsies to read and to write. Experimental subjects lived in "Santa Catalina", a slum outside Madrid. They were invited to participate in an experiment in which they could earn some money. As the result of this "public call" the day of the experiment appeared 38 students. The later reduces the representativeness of our sample; as subjects were students of a school for adults, maybe they shared some special features and social norms that could make them different from other gypsies, so we cannot generalize our results to the whole gypsy population (although, as we will see below, our sample shares the main social and cultural features with the rest of Spanish gypsy population).

The experimental session was conducted by three experimenters[27] in three basic steps: *i*) all the subjects orally received the instructions in a common room; they also received a numerical code (identification) for each one. Individuals did not give their names, they were identified only with the numerical code[28].

ii) Once subjects were completely informed about the experiment, they went to another room where each experimenter conducted: 1) the SMUG (see BCD),

[27] Six nuns helped the experimenters but they only participated in the questionnaire. They did not know anything about the experiment (so they could not influence subjects' responses).

[28] In this way we preserved the anonymity of individuals, so results were not influenced by problems of identification between subjects. We expected sincere responses given that nobody knew which were the responses of the rest of the individuals.

2) in a second room they fill the full CORE survey and 3) finally in the bottom of the second room the inequality aversion device.

iii) After subjects finishing the SMUG, they received 3€ show–up fee and at the end they received the SMUG earning (5 euros on average).

Spanish gypsies

The Spanish gypsies come from the first migratory waves of Roman into western Europe, which ended in the second half of the 15th century (see Gamella & Martin [9]). Spanish gypsies have contributed much to Spanish culture and folklore, specially in Andalusia, where many of the symbols and practices which identify the region to the world have a crucial gypsy component (see Leblon [18]). The number of gypsies in Spain is approximately 600,000. Spanish gypsies live in permanent settled communities (almost all Spanish gypsies are sedentary). They inhabit 95% of slums around large cities in Spain. Neighborhoods are characterized by lack of running water and lack of police presence. However, levels of poverty and social discrimination are less significative for Spanish gypsies than for communities in Central and Eastern Europe.

Gypsy society as a whole is structured around extended family units. Individuals belong to a single unit. Gypsy society has no written rules. Instead, the entire set of social norms is transmitted by observation and imitation (see Lancy [16]) or it can be transmitted orally from generation to generation. Thus the older members play a key role in the society and are looked up to by the whole population who hold their experience and knowledge in high esteem. Related

to the size of the families, the average size of a Roman family is 5.4 members, in comparison with 3.7 *members* of a non-Roman Spanish family.

Three basic social rules govern gypsy society: *i*) solidarity among gypsies (which includes hospitality and aiding others), *ii*) freedom as a natural condition of the people and *iii*) symbolism as a representative feature of gypsy culture. This includes flamenco, which is considered to be an expression of gypsy lifestyle.

Today the life and traditions of Spanish gypsies are being rapidly transformed. These changes affect differently depending on the social status of the individual, thus gypsy population is increasingly heterogeneous, even polarized, between the new middle class and a gypsy underclass affected by poverty and social exclusion (see Gamella [8]).

The literacy enrollment and school attendance rates are very low among Roman. A very small percentage of Roman finish the basic education in Spain. The labor market for Roman families is very different from the rest of population. Jobs are low paid and there exist few hold salaried full-time jobs. Around 50-80% of gypsy population works in peddling, collecting solid urban waste and performing personal work.

The points above are applicable to the entire population of gypsies living in Spain. Next section explores our specific population, Spanish gypsies from Vallecas. Results of the questionnaire show that this sample shares the main socio-economic features with the whole Spanish gypsy population (see Gamella [8], Ringold et al. [20], Martin & Gamella [9] or Gómez Alfaro [11] among others).

Descriptive analysis of our population

In this section we only focus on the most relevant items obtained from the CORE questionnaire[29] (related to socioeconomic and cultural features of this specific sample) that we will use as explaining factors of inequality aversion.

Table 1a and 1b show the items and summarize the main findings for the 38 subjects who attended the experiment (N means number of observations). Next table 1a shows the percentage of population which hold the selected characteristics and table 1b shows the average of some numerical attributes.

Related to education features, 93% of population has some level of education, this percentage seems very high, but it is amazing to note that these people consider the fact of learning to read and write as an educational level achieved. In relation to personal variables, tables 1a and 1b show that 73% of population is married, 86% has children and the mean number of children is almost 3.

Also note that population is very poor, for instance only 1 up to 38 subjects owns his house, none has lands only 1/3 of the population has swatch and 70% of the population has not a car. Another indicator of the wealth level is that 83% are unemployed.

Now we explore some of most representative variables which the CORE protocol introduces: these variables refers to *cooperation* and *social integration* (networking). As table 1a and 1b show, 15% of our population is a volunteer in an association and 24% is associated to a club. The mean number of hours

[29] Although the whole CORE questionnaire contains a larger set of items to perform this investigation we selected the most 40 relevant variables for urban population in Western countries.

spent in clubs is around 5 hours per week for people belonging to a club. The mean number of hours dedicated to volunteer activities is about 1 hour in a week.

Table 1a: Some Population Features I

Attribute	%	n	Attribute	%	n
PERSONAL			EDUCATION		
female	68	38	some level of education	93	37
is married	73	37	goes to school	65	38
lives with his partner	67	33	WEALTH		
has children	86	35	house ownership	3	34
was born in Madrid	63	38	has not swatch	64	38
was born in a rural village	18	33	not satellite television	87	38
is family head	54	35	has not radio	24	38
SOCIAL CAPITAL			has not car	70	38
houses with only one food	16	38	has lands	0	38
houses with guests	54	37	is unemployed	83	23
is associated to a club	24	34	OTHER		
is volunteer	15	33	gypsy boss	0	4
does not trust in people	56	36	thinks they live in a safe home	74	38
RELIGION					
goes to church	59	29			
has religion	75	36			

Table 1b: Some Population Features II

Attribute	Mean	n	Attribute	Mean	n
PERSONAL			EDUCATION		
age	28.79	37	years of schooling	3.6	25
number of children	2.57	30	JOB		
number of brothers	6	38	hours worked/week	24.6	10
position among brothers	3.84	38	gypsy colleg./job	15.3	3
RELIGION			SOCIAL CAPITAL		
churchatt. days/month	21.61	18	people living in a house	4.76	38
			guests for lunch/day	5.73	22

Interestingly, the mean number of guests for lunch is close to 6. The latter feature jointly to the mean number of brothers (six, which is very high if we compare to average number among Spaniards, 1.7) and the above variables that indicate subjects cooperative behavior (club membership, voluntaryism...) may be helpful to predict a "sharing" behavior of the gypsy population.

Results

Previous to analyze our results we will show some interesting arguments given by our volunteers during the experimental session. We classify subjects according to their level of inequality aversion.

i) On the one hand, 52.6% (20 of 38 subjects) preferred played their own lottery, that is, they are inequality Lovers. From those individuals we may

extract the next sentences, that summarize the most usual responses:

- my fortune is mine.
- is better if each one play his own lottery.
- it wouldn't be fair if just because she's unlucky the rest of us have to be unlucky too.

ii) On the other hand, 47.4% (18 of 38 subjects) preferred played the same lottery for all individuals, that is, they are INEQUALITY AVERSE. From this population we show the most usual explanations:

- is better if all of us get the same.
- it is better if all of us get the same, because we avoid problems; if anybody earn more money other subjects may feel offended.

Next part of this section deeply examines the connection between inequality aversion and the features of the population extracted from our survey, that is, the relationship between inequality aversion and the variables obtained through the CORE questionnaire.

Table 2 shows the results for a logit model, where the dependent variable is inequality aversion (which is a binary variable which takes value 1 for inequality aversion).

Now, we summarize the most striking results. One overwhelming result is the *gender* bias for this sample: females are more averse than males. Interestingly,

older individuals are less averse than youngest which means that aversion is decreasing in *age*.

Other items related to subjects' personal features are also interesting: *Marital status* plays a relevant role on aversion, subjects with spouse are more averse. The *number of children* is also a positive determinant of aversion and similarly the *number of individuals living in the same house* is also positive. In the same direction, individuals who are *family heads* are more inequality averse. However, the *number of brothers* is not statistically significant (note that the number of brothers does not depend on the subject, so it does not increase his sense of responsibility). This set of variables reflects that the larger responsibility the larger inequality aversion. This result seems to be quite sensible!

A surprising result is that individual *wealth* does not play any role on subject inequality aversion. This can be due to the fact that the differences in wealth among subjects are negligible.

Individual training (*education*) affects aversion in an amazing way: individuals schooling decreases inequality aversion, probably because subjects endowed with more education are more competitive.

Another surprise is that *religion per se* does not affect, i.e. is not statistically significant, whereas *church assistance* affects. In fact, subjects church-attendance increases their aversion level.

The sense of safety and trust decrease aversion.

Table 2: Results for logit regression

VARIABLE	PARAMETER	STANDARD ERROR
constant	-0.51*	0.18
male	-0.18*	0.05
age	-0.02*	0.00
school assistance	-0.49*	0.06
wealth	-0.01	0.03
religion	-0.05	0.04
church assistance	0.36*	0.06
married	0.18*	0.05
children	-0.55*	0.06
n^o of children	0.25*	0.04
brothers	-0.01*	0.00
family head	0.48*	0.05
size of family	0.09*	0.01
only one food	0.31*	0.04
guests for lunch	0.01*	0.00
sense of safety	-0.09*	0.05
club membership	0.36*	0.07
volunteer	0.09	0.09
trust	-0.23*	0.01
σ	0.23*	0.01

*significative at 1% level.

Regarding subjects social integration we extract some notable estimations. The *number of guests invited for lunch* increases aversion. Although its effect is slight we may explain this result directly: more averse subjects are willing to invite more people to their home. In the same way, individuals who are *club memberships* are more averse. However there is not inequality aversion behind subjects participation as *volunteers* in some activities.

Concluding remarks

This paper analyzes the determinants of inequality aversion among Spanish gypsies in Vallecas. In particular, this work studies the relationship between inequality aversion and the most relevant items from the CORE questionnaire, using a logit specification.

First of all, using a procedure similar to that developed by Kroll & Davidovitz we extract that roughly half of the population participating in the experiment is inequality averse. In order to investigate the causes of this result, we base our analysis in the particular features (obtained through a questionnaire) of this population , many of them are shared by other gypsy populations (see for example Gamella [8]).

Results of the logit model show that gender and age affects inequality aversion. In particular females and younger individuals are more egalitarian. Family responsibilities (position, number of children and so on) also affects positively inequality aversion. Education makes not more egalitarian individuals, this can be due to a competitive environment in the school. Religion is also a positive in-

fluence for egalitarianism but only for those who practice it regularly. Logically, social integration affects positively inequality aversion.

Finally, observe that these results cannot be extrapolated to all gypsy populations in the world. However, as we have shown in section 4, Spanish gypsy population shares the most relevant socio-cultural features of our experimental population, so results could be generalized to the Spanish gypsy population.

References

[1] Bolton, G.E. and A. Ockenfels (2000) ERC: A theory of Equity, Reciprocity and Competition. *American Economic Review*, **90**: 166-193.

[2] Brañas-Garza, P., Cobo-Reyes, R. and A. Domínguez, (forthcoming). Si él lo necesita: gypsy fairness in Vallecas, *Experimental Economics.*

[3] Charness, G. and B. Grosskopf (2005) Relative payoffs and happiness: an experimental study. *Mimeo*

[4] Deardorff, A.V. Glossary of economics at http://www-personal.umich.edu/~alandear

[5] Fehr, E. and Schmidt, K. M. (1999) A Theory of Fairness, Competition and Cooperation. *The Quarterly Journal of Economics* **114**: 817-868.

[6] Ferraro, P. and R. Cummings (2005) Experimental approaches to understanding conflict over natural resources. *Water Policy Working Paper* **016**.

[7] Friedman, M. and L.J. Savage (1948) The Utility Analysis of Choices involving Risk. *Journal of Political Economy* **56**: 279-304.

[8] Gamella J. (2005) Exclusión social y conflicto étnico en Andalucía. *Gazeta de Antropología* **18**.

[9] Martin E. and J. Gamella (2002) Marriage practices and ethnic differentiation: the case of Spanish gypsies. *The History of the family* **10**: 45-63.

[10] Gay Blasco, P. (1999) Gitanos of Madrid. *Oxford, Berg.*

[11] Gómez Alfaro, A. (1998) Gitanos de Priego de Córdoba: entre el acoso y la supervivencia. Legajos. *Cuadernos de investigación histórica del sur de Córdoba*, **1**: 61-72.

[12] Henrich J. and J. Esminger. (2002-2005) The Roots of Human sociality: an ethno-experimental exploration of the foundation of Economic Norms. *Project of California Institute of technology division of the humanities and social sciences.*

[13] Henrich J. (2000) Does Culture matters in Economics Behaviors: Ultimatum Game Bargaining among Machiguenga. *American Economic Review* **90**: 973-980.

[14] Henrich J., Boyd, R. Bowles, S. Camerer, C. Gintis, H. McElreath, R and E. Fehr (2001) In search of Homo economicus: Experiments in 15 small-scale Societies. *American Economic Review* **91**: 73-79.

[15] Kroll, Y. and L. Davidovitz (2003) Inequality aversion versus Risk aversion. *Economica* **70**: 19-29.

[16] Lancy, D. (1996) Playing on mother ground: cultural routines for children's development. *London: The Guildford Press.*

[17] Laurelle, A. and F. Valenciano (2005) Assessing success and decisiveness in voting situations, *Social Choice and Welfare* **24**:171-197.

[18] Leblon, B. (2003) Gypsies and Flamenco, *University of Hertfordshire Press.*

[19] Loewenstein, G., Thompson, L. and M. Bazerman (1989) Social utility and decision making in interpersonal contexts. *Journal of Personality and social Psychology* **57**: 426-441.

[20] Ringold, D., Orenstein, M. and E. Wilkens (2005) Roma in an Expanding Europe: Breaking the Poverty Cycle. Washington. *The World Bank*.

[21] Sánchez, M. H. (1986) Evolución y contexto histórico de los gitanos españoles. In T. San Roman, Entre la marginación y el racismo. Reflexiones sobre la vida de los gitanos. Madrid. *Alianza Editorial*.

Capítulo 3: Social Networks

An experimental device to elicit social networks

Introduction

There is a growing literature[30] which highlights the importance of the **structure** of *social networks* in our social and economic life. These works explore (both theoretically and empirically) how the existence of social networks influence individuals' behavior in a wide variety of contexts, from job search to information transmission within a firm[31]. In this respect, being capable to properly map the structure of a network becomes crucial to understand how the network structure influences individuals' behavior and, vice versa, which is the impact of individuals' decision on the social network's performance.

One of the reasons why, so far, the interest of the literature on these matters has been mainly theoretical, comes from the difficulty of measuring the structure and strength of social relationships in real-life contexts. By the same token, also the experimental literature works on environments in which the network is **exogenously** induced using monetary incentives.[32]

To the best of our knowledge, the seminal paper which proposes (and tests

[30] Take, for example Montgomery [20], Granovetter [14] or Calvó-Armengol and Jackson [5] which deal with job search through social contacts; Bloch [2], Goyal and Moraga [13] develop models related to industrial organization, specifically collusive alliances among corporations; Kranton and Minehart [18], and Wang and Watts [26] which analyze trade in non-centralized markets.

[31] Another different context can be found in Reuben & van Winden [22] where they evaluated reciprocity and emotions with an incomplete and inexact social network. They concluded that the complete social network is needed to better analyze this kind of problems.

[32] Examples of the experimental research include COORDINATION networks (see Keser et al. [16], Berninghaus et al. [1], Corbae and Duffy [9], among others); COOPERATION networks (see Kirchkamp and Nagel [17], Cassar [6] or Riedl and Ule [24]); BUYER-SELLER networks (see Charness et al. [7]) network FORMATION (see Deck and Johnson [10], Callander and Plott [4], and Falk and Kosfeld [11] and Vanin [25]).

experimentally) a mechanism for network elicitation, is that of Mobius, Rosenblat & Quoc-Anh [19] (MRQ, hereafter)[33]. In their paper they develop the network elicitation mechanism[34] as follows: *i*) the experiment was conducted via internet, *ii*) the mechanism was a coordination game where subjects received 50 cents only if they named each other with 50 percent probability and zero otherwise, *iii*) subjects were asked how much time they spend on average per week together as a measure of link strength (if subjects agreed on this dimension of their friendship, with an error of half an hour, the probability of obtaining the money increased from 50% to 75%). Results obtained by MRQ mechanism were the following: *i*) 37% of links were symmetric links where both subjects had named each other *ii*) of those, 80% coincided in the time they spend together (± half an hour), and *iii*) the average number of friends elicited was 10 (most participants spent less than half an hour with their 10th friend).

MRQ mechanism motivates this paper. We consider that there are three potential problems in MRQ device *i*) as the experiment is conducted via internet, there exists the possibility of subjects speaking with each other about the game before answering *ii*) this game really gives subjects strong incentives to name a lot of people, given that it does not establish any kind of punishment if individuals do not coordinate in naming each other, *iii*) participants must have friends in order to earn money, moreover the earnings in expected terms are

[33] There are some papers which also deal with social networks but their main goal is not the elicitation of the network but to use a network for a particular experiment. Reuben [23] and Brañas-Garza et al. [3] are some examples.

[34] The aim of their paper was to measure social capital in a real-world social networks, so they conduct a Dictator Game controlling for the variable "friendship".

decreasing in the number of friends.

We develop a new mechanism which differs with MRQ mainly in the following dimensions: *i*) we set up a mechanism in which we reward the decision of abstaining to elicit any link, the reason is that people may not be willing to reveal private information –such as friends– since they might be aware of any negative consequence in the use of this information. So, although the analysis of the game would be much more difficult, for ethical reasons we consider that individuals should have an "exit" option (obtaining the **maximum payoff**). *ii*) In our mechanism, strength is measured on a not observable scale (as opposed to some observable measure, such as time spent together), we directly ask subjects about the level of the relationship, so we obtain the measure of this strength directly from subjects and we do not use a proxy for this variable and *iii*) Incentives are not only monetary, we use as well class grades, the main reason for this is that we consider that class grade is also a relevant payoff in the specific context we are analyzing: the classroom network.

Why a mechanism? Without incentives, some problems could arise. One of them would be that some subjects could be against revealing information about themselves to some unknown experimenters. Other potential problem would be that individuals are not going to take the task very seriously, so elicited links wouldn't reflect the real social network. Section 3 shows the results from a treatment without any kind of incentives, which highly support the necessity of a mechanism, given that only 5% of sent links were corresponded. Moreover, 13% of subjects didn't give us the permission to use their data.

To test the robustness of the mechanism to changes in rewards, we have conducted a session with monetary incentives. The results obtained are very similar to the extra-credit point treatment and are explained in detail in Section 3.

Our main experimental results are: *i*) the number of corresponded links is extremely high (75% were corresponded, from which 80% are "exactly", according to our definition), *ii*) very few subjects choose not to name any friend, *iii*) all subjects have at least one link corresponded "exactly", *iv*) the average number of friends elicited is 4.5.

The remainder of the paper is arranged as follows. Section 2 describes the experimental design and procedures, while Section 3 reports the experimental results for the three treatments. Section 4 is devoted to develop a model which explains empirical results. Finally, Section 5 concludes.

Experimental design & procedures

Rewards

We conducted three treatments with different rewards, extra-credit points (TP), monetary (TM) and no incentives (TNI). All sessions were run as classroom experiments. We used classroom frame instead of voluntary participation because (*i*) to elicit a network first you need a real network, obviously the class is the closest network we have access and (*ii*) also, we supposed that (apart from monetary rewards) extra–credit points was one of the relevant payoff in this real situation: the class network. In the TP session, experimental subjects

could receive either one extra-credit point or nothing (the grade system in Spain ranges from 0 to 10).

We have also used monetary rewards (5 Euros), to test the robustness of our mechanism to changes in the incentives. Instructions were identical in TP and TM except for the reward. In section 3 we show that main results remain in TM treatment.

The last treatment was conducted without any kind of incentives. There were neither game instructions nor rewards, so subjects simply were asked to reveal some information of their friends as in a mere questionnaire. In the Network Elicitation Mechanism subsection, we explain in detail which kind of information was requested from participants.

To clarify ideas, instructions in the appendix show the difference between the three treatments TP, TM and TNI.

Subjects

The experiments with the extra-credit point were conducted, in order to ensure the *maximum attendance* [35], in June 2004 during the exam of Microeconomics II, a first year course, at the University of Jaen. We included a "special question" as an additional item of the final exam. Students have very little exposure to game theory. We ran the experiment in three classes: Group 1 was made of students from the Degree in Business Studies (Group 1: morning and Group 2:

[35] To analyze the correspondence between links it was necessary to ensure the maximum attendance. If one individual who had been named did not play the game, it was impossible to verify if the link sent to this subject was corresponded. This situation would be problematic in order to study of the performance of our mechanism.

evening groups) and Group 3 Degree in Law and Business (unique group) at the University of Jaen (Spain). These three groups consisted of 51, 53 and 31 students respectively.

The unique monetary incentives (TM) session was conducted in February 2006 at the University of Granada. The group was compounded of 39 students from Microeconomics I, a first year course in Economics Degree (they had no training in game theory)[36].

The TNI treatment was conducted also at the University of Granada in February 2006. The sample was 40 students from Microeconomics I, a first year course in Business Degree[37].

Network Elicitation Mechanism (NEM)

The basic structure of the Network Elicitation Mechanism (NEM hereafter) is as follows. We asked the students to reveal the name and surname of their friends within the population and, in a scale from 1 to 4, the strength of each relationship.

Let s_{ij} define the "score" given by i to the ij relationship. This score ranges from 1 to 4 as follows[38]:

[36] As this treatment was not conducted during an exam, the maximum attendance was not guarantied. So, we have had to remove from our sample some links whose correspondence could not be verified.

[37] This group neither had training in game theory. As in TM session, in this treatment we had to remove some links which could not be checked.

[38] Note that we have used a strength which ranges from 1 to 4 instead of only score 1 or 2 for acquaintances or friends respectively. The reason is that we wanted to increase the possibilities of players when they valued the relationship. The idea was to relax the classification of friendship. Increasing the space of strategies we reduced the transcendence of the decision and it would facilitate players' decisions about some partners.

$s_{ij} = 1$: j is an acquaintance of i

$s_{ij} = 2$: j is a close acquaintance of i.

$s_{ij} = 3$: j is a friend of i.

$s_{ij} = 4$: j is a close friend of i.

Notice that we use the term ACQUAINTANCES to define "weak" social relationships ($score = 1, 2$), whereas we use the term FRIENDS to define "strong" social relationships ($score = 3, 4$). Finally, if individual i does not name individual j, we set $s_{ij} = 0$. Remark that ij or (i, j) represents a directed link from i to j[39].

NEM incentives for the TP treatment are described as follows. Subjects would receive a fixed prize (an extra point (out of 10) in their final exam)[40] under these two CASES:

- CASE 1: if they did not name anybody, or
- CASE 2: if they named at least one subject, if all of the following three rules apply.

rule 1 One out of the elicited links was chosen at random (each link selected with equal probability). Let j denoting the subject named in the randomly selected link;

rule 2 Subject i would receive the price only if also j has named her (i.e. only

[39] A directed graph G is an ordered pair $G := (V, A)$ with V, a set of vertices or nodes, and A, a set of ordered pairs of vertices, called directed edges or links (i, j). In other words, a graph or network in which relations among points or vertices are either unequal and reciprocal or non-reciprocal.

[40] For TM treatment, the fixed priced for the experiment was 5€.

if $s_{ij} \neq 0$). That is, if Bill named Jimmy Carter and, Jimmy named Bill Clinton (both names and surnames).

rule 3 For obtaining the payoff, the friendship score should be also accurate, that is, if $D_{ij} = |s_{ij} - s_{ji}| \leq 1$, $s_{ij} \neq 0$, i.e. the difference in the scores given by i and j is not higher than 1.[41]

There is another feature of our mechanism which is worth to mention at this stage. According to CASE 1 subjects would secure the prize for themselves not naming anybody. As we have already mentioned, we state this rule to provide an "exit" option for subjects with no friends or reluctant to reveal private information. We were aware that this rule could be a potential problem to elicit the whole network. However, to ease this setback, we exploit the fact that subject i may damage all subjects j who have named i if she doesn't name anybody. So we decided to highlight this possibility in the experimental instructions by explicitly warning subjects that their friends could be damaged by this decision, since "*those subject who named them could lose the prize*" (see instructions in the appendix).

Game-form and equilibria

Given CASES 1 and 2 the game-form of our mechanism is defined by $G = \{N, S_i, \pi_i\}$, where $N = \{1, 2, ..., n\}$ is the finite set of subjects, $S_i = \{s_{ij} \in$

[41] Note that rule 1 relaxes the mechanism, another possibility would have been to eliminate rule 1; so, all links for each individual would be checked. In this case individuals would perceive a high probability of losing the prize, so they would have incentives not to name anyone. As we consider the punishment would be extreme, we introduce rule 1.

$\{0,1,2,3,4\}\}_{j\neq i}$ is the set of strategies of subject i and $\pi_i(\cdot)$ is the outcome function of subject i. The strategy vector of subject i over all relationships with all individuals in N is denoted as $\mathbf{s}_i = (s_{i1}, s_{i2}, ..., s_{ii-1}, s_{ii+1}...s_{in}) \in S_i \subset \Re^{n-1}$ and a strategy for each individual in N is denoted as a matrix containing all strategy vectors, $\mathbf{s} = (\mathbf{s}_1; \mathbf{s}_2; ...; \mathbf{s}_n) \in \prod_{i\in N} S_i \subset \Re^{(n-1)n}$. To define the outcome function $\pi_i(\mathbf{s})$, let $J_i = \{j \in N \setminus \{i\} \mid s_{ij} > 0\}$ be the set of subjects named by individual i, and $j_i = |J_i|$ its cardinality. Let also $\hat{\jmath}$ be the index indicating the subject randomly selected by the mechanism in case $j_i >0$, i.e. a random variable which can take any value within the range $\{1, 2, ..., j_i\}$ with probability $\frac{1}{j_i}$ (rule 1) only if $j_i > 0$. Then

$$\pi_i(\mathbf{s}) = \begin{cases} 1, if \begin{cases} D_{i\hat{\jmath}} \leq 1 \; and \; j_i > 0 \\ j_i = 0 \end{cases} \\ 0, \; otherwise \end{cases}$$

To analyze the equilibria of this game we need to reduce its dimension, that is, we will show that this n-player game can be considered as $\begin{pmatrix} n \\ 2 \end{pmatrix}$ 2-player games. The intuition behind this result is as follows. When Player i has to decide which strategy to play with each Player j in the group, i will play this game as if this concrete Player j were the one randomly chosen for being checked (rule 1) given that each link is selected with the same probability. Thus, Player i will choose *independently* a strategy s_{ij}, maximizing her payoffs, for each of the players in the class ($\forall j \in N$). In sum, we state that n subjects playing NEM is equivalent to every pair of subjects (i, j) playing the 2-player game represented in next figure 1.

Figure 1: 2-PLAYER REDUCED NEM GAME

s_{ji} / s_{ij}	**0**	**1**	**2**	**3**	**4**
0	1 1	0 1	0 1	0 1	0 1
1	1 0	1 1	1 1	0 0	0 0
2	1 0	1 1	1 1	1 1	0 0
3	1 0	0 0	1 1 2	1 1	1 1
4	1 0	0 0	0 0	1 1	1 1

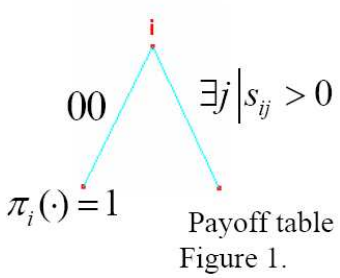
The following proposition 1 states formally the relationship between the NEM and the Reduced NEM game equilibria.

Proposition 3 *A strategy* $\mathbf{s}^* \in \prod_{i \in N} S_i$ *is a pure Nash equilibrium of the NEM if and only if* $\left(s_{ij}^*, s_{ji}^*\right)$ *is a pure Nash equilibrium of each of the* 2×2 REDUCED NEM GAME *for any pair of players* $(i, j) \in N$.

Proof. See appendix 2. ■

After this proposition we can illustrate the NEM game in next figure 2 in the extensive form:

Figure 2: NEM GAME EXTENSIVE FORM.



At the beginning of the game, player i has to decide between two options: i) not naming anybody ($s_{ij} = 00$): which means to play $s_{ij} = 0, \forall j \in N$ (assuring the extra credit point) and, ii) naming at least one individual of N ($\exists j | s_{ij} > 0$). If player i chooses the first option, the payoff will be 1. The second option leads player i to play with each individual j in N according to the payoff table described in figure 1. From figure 1 and figure 2, it is clear that $s_{ij} = 0$, $\forall j \in N$ is a weakly dominant strategy.

Note that the NEM can be considered as a coordination game in a certain sense, with some particular features: (i) there are two different possibilities of coordination, "negative coordination" –subjects do not name each other–, or "positive coordination" –subjects name each other–, (ii) "positive coordination" is only plausible if both subjects know the name and surname of each other and

(*iii*) errors are permitted only in "positive coordination".

From figure 1 we can compute the set of Standard Nash equilibria in pure strategies for the 2-player Reduced NEM game[42]:

$$NE_2 = \left\{ \begin{array}{c} (0,0),\ (1,1),\ (1,2),\ (2,1),\ (2,2),\ (2,3), \\ (3,2),\ (3,3),\ (3,4),\ (4,3),\ (4,4) \end{array} \right\}$$

From proposition 1 we can compute the equilibria for the n-player NEM game by calculating the variations with repetition of those 11 equilibria (the total number of equilibria is $11^{\binom{n}{2}}$). Thus, the set of Standard Nash equilibria in pure strategies for the n-player NEM game is:

$$NE_n = \left\{ (\mathbf{s}_1^*; \mathbf{s}_2^*; ...; \mathbf{s}_n^*) \in \prod_{i \in N} S_i \,\middle|\, \left(s_{ij}^*, s_{ji}^*\right) \in NE_2,\ \forall i, j \in N,\ i \neq j \right\}.$$

Results

After the brief overview of the NEM main properties, we evaluate the performance of the NEM device. To explore in depth NEM outcome, we analyze results in two ways: *i*) aggregate results to measure our NEM ability to obtain the latent network and *ii*) results per capita to complete the description of the obtained network. Remember that the whole experiment comprises 3 different groups ("networks") NET I, NET II, and NET III, with 51, 53 and 31 students respectively. Table 1 summarizes the verification of the experimental

[42] As this is a one-shot game it isn't very useful to compute mixed strategies equilibria.

device for the three networks. Note that CORRESPONDED links mean that rule #2 is fulfilled (rule #3 can be fulfilled or not), whereas NON-CORRESPONDED referred to links which fail rule #2 and EXACT STRENGTH means that the referred link has been corresponded with the same score, i.e., rule #2 is satisfied and rule #3 holds with $D_{ij} = 0$ (see page 103).

Table 1: NEM VERIFICATION

	NET I		NET II		NET III		TOTAL	
	#links	%	*#links*	%	*#links*	%	*#links*	%
CORRESPONDED	220	76%	115	70%	114	75%	449	74%
(exact strength)	(180)	82%	(82)	71%	(98)	86%	360	80%
NON CORRESP.	69	24%	50	30%	38	25%	157	26%
TOTAL	289		165		152		606	

From Table 1 we state the following.

Result 1 (main): *On average, around 75% of our networks links are corresponded.*

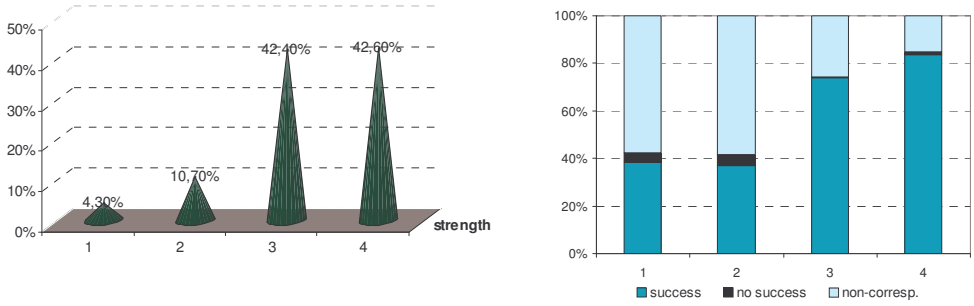
The later means that a remarkable percentage of links fulfill rule #2 (see page 102). Note that this result is remarkable since our accuracy rate doubles the previous experimental evidence (some 36,7% in Mobius *et al.* [19]). Also, our NEM provides a measurement of the strength of the relationship. The good performance of our NEM is also confirmed by

Result 2: *On average, around 80% of the corresponded links show an exact strength.*

The above results show an overwhelming rate of correspondence between links (in spite of the fact that the probability of coordination without information is very low because individuals can play a lot of strategies).

We now focus on the *strength* of elicited links and their relative accuracy. Figure 3a) reports the relative frequency of each strength s_{ij} in the whole set of links[43].

Figure 3: STRENGTH AND ACCURACY OF ELICITED LINKS



a) Frequency of strength.

b) Percentage of corresponded links.

Thus, figure 3a) shows that the number of links associated to acquaintance relations is very small (15% over the total). Moreover, that the frequency of links associated to "friends" ($s_{ij} = 3$) and "close friends" ($s_{ij} = 4$) is very similar. This evidence is summarized in the following

Result 3: *Our NEM largely captures "friendship" relations (some 85%) and practically ignores "acquaintance" relations.*

[43] This frequency is an average of the three sessions conducted for the TM.

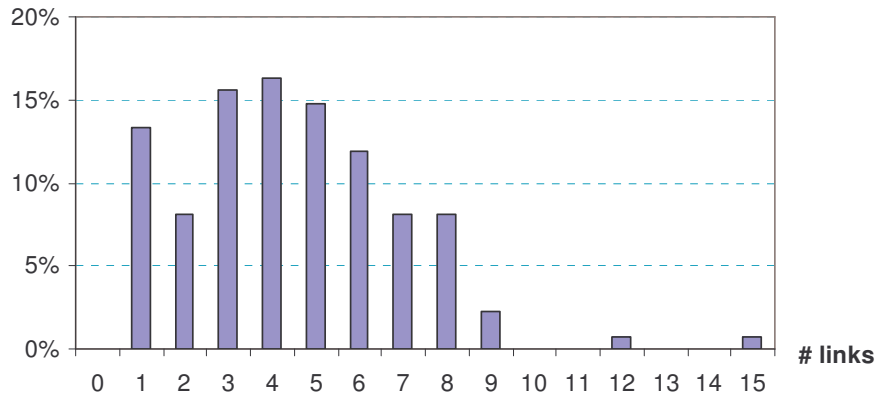
Figure 3b) reports the percentage of SUCCESSFUL links –those links which fulfill rule #2 and rule #3 but not necessarily with $D_{ij} = 0$ (this is the difference with EXACT STRENGTH links), (see page 103)–, the NON-SUCCESSFUL links – those which fulfill rule #2 but fail rule #3- and NON-CORRESPONDED ones. Observe that coordination occurs much more frequently when subjects elicit friendship relationships rather than acquaintances:

Result 4: *Accuracy increases with the level of friendship.*

The above results clearly show that NEM mainly captures *friendship relations.*

Figure 4 reports the relative frequency of links *per capita* of our 135 participants.

Figure 4: LINKS PER CAPITA



Result 5: *The average number of links per capita is 4.49; with a range from 1 to 15 links. The median value is 4 and the mode is also 4.*

Result 5 shows that subjects name some friends and nobody decide to say that he has not any friend. Then, the following question arises: do subjects feel ashamed of saying they have no friends and then they always name someone? If the answer were positive then, there would exist some players who named partners randomly and they would not be corresponded at all[44]. The 135 participants were corresponded once at least; this statement, jointly to the fact that the probability of random coordination was close to zero, let us conjecture that subjects did not choose any partner randomly.

Recall that eliciting zero friends allowed subjects to get the prize for sure. As Figure 4 shows, *no subject opted for this option:*

Result 6: *All subjects revealed at least 1 link.*

The rest of this section explores first the strength of links that subjects sent **per capita** in the 3 networks and afterwards we study the probability of correspondence per capita.

Now, we will analyze the average strength per capita. Let $\widetilde{\ell_k}$ denote the average number of links sent per capita with strength k, where $k \in \{1, 2, 3, 4\}$, that is:

[44] The probability of "positive coordination", given that the population is sufficiently large and strength must be "accurate", is close to zero even in the case a subject knows the name and surname of all people in his class.

$\widetilde{\ell_k} = \dfrac{\sum_R \left(\dfrac{\ell_R(k)}{n_R} \right)}{3}$, where $n_R = card\{N_R\}$ (# subjects in network R, $R \in \{I, II, III\}$) and $\ell_R(k) = card\{s_{ij} = k \mid i, j \in N_R\}$ (# total links sent with strength k in network R). Then, we have that $\widetilde{\ell_1} = 0.19$, $\widetilde{\ell_2} = 0.50$, $\widetilde{\ell_3} = 1.96$ and $\widetilde{\ell_4} = 1.88$. For instance, $\widetilde{\ell_2} = 0.50$ means that on average in each of the three networks, each subject sent 0.5 links with strength 2. Comparing these measures, we state:

Result 7: *The number of links sent to friends is four times larger that those sent to acquaintances. Also note that* $\widetilde{\ell_3} > \widetilde{\ell_4}$ *and* $\widetilde{\ell_2} > \widetilde{\ell_1}$.

However, the large percentage of subjects sending links with strength $s_{ij} = 4$ implies that *subjects do not play strategically with friends*[45], i.e., subjects do not name all friends with strength $s_{ij} = 3$.

It is also interesting to analyze the average percentage of non–corresponded links per strength and per capita, that is, to study when subjects fail naming other player.

Let $\widetilde{c}_k$ denote the average **percentage** of corresponded links per capita with strength $s_{ij} = k$, that is:

$\widetilde{c}_k = \dfrac{\sum_r \left(\dfrac{\dfrac{c_R(k)}{n_R}}{\widetilde{\ell_k}} \right)}{3}$, where $c_R(k) = card\{s_{ij} = k \mid D_{ij} \leq 1, i \in N_R\}$.

The obtained values are: $\widetilde{c}_1 = 0.31$; $\widetilde{c}_2 = 0.32$; $\widetilde{c}_3 = 0.74$; $\widetilde{c}_4 = 0.86$.

[45] To play strategically means that once a subject decides to name a friend (or acquaintance) and given that the difference in strength must be lower than 1 ($D_{ij} = |s_{ij} - s_{ji}| \leq 1$) to obtain the payoff, the optimal strength is 3 for friends (2 for acquaintances). See figure 1 for a detailed analysis of the strategies and equilibria.

Result 8: *On average, the* ***percentage*** *of corresponded links is clearly larger for* friends *than for acquaintances. Also note that* $\widetilde{c}_4 > \widetilde{c}_3 > \widetilde{c}_2 > \widetilde{c}_1$.

In sum, previous results indicate that the number of friendship links ($s_{ij} > 2$) is larger than acquaintances. In sum,

Remark 4 *The NEG captures srong socila relations and nearly ignores weak relations.*

Comparison with no incentive treatment (TNI)

This section highlights the importance of a mechanism to elicit in a more rigorous way a social network. Moreover, results obtained give evidence of some problems which can arise if there are no incentives. One of the potential problems is that some individuals could be reluctant to reveal private information. Another one, might be that subjects do not take the task very seriously, so elicited links would not reflect the real social network. Table 2 compares results between an unique session run with no incentives (TNI) and the average of the three sessions conducted with credit point reward (TP)[46].

Table 2: Comparison no incentives (tni) & credit point(tp).

	N	CORRESP	EXACT	NO PERMISSION
TNI	40	4.85%	60%	13%
TP	45	74%	80%	0%

[46] As we have seen above, results in the three sessions of TP have very similar results, so the average is a good approximation.

In table 2, N is the average number of subjects, *corresp* is the percentage of corresponded links, *exact* is the percentage of links with exact strength from the corresponded links, and *no permission* refers to the percentage of people who did not sign the authorization[47] to use their data of the experiment (obviously, they did not name anybody or give their own name).

Table 2 supports the above considerations about the potential problems which can emerge when using no incentives. On one hand, related to the problem that individuals maybe do not want to reveal private information, 13% of individuals did not allow us to use the information requested in the experiment. On the other hand, the second result shows the amazing high difference in the percentage of corresponded links, 4.85% in TNI as against 74% in TP (so, the network obtained in TNI is not a good approximation of the real network).

In sum, when incentives are not provided the obtained network seems to be unrealistic and less rigorous than if an appropriate mechanism is used.

Comparison with monetary rewards treatment (TM)

Now, we compare our treatment with points (TP) with those data generated with monetary rewards (TM). TP and TM share most of the features. Table 3 shows the main results for the two treatments.

[47] At the end of the experiment we asked subjects for signing a written authorization allowing us to show the results of their responses in this paper (of course, we assured subjects' anonymity in the process of showing the results).

Table 3: Comparison monetary (tm) and extra-credit point (tp).

	n	corresp	exact	successful	no name	%3,4 (corresp)	%1,2 (corresp)
TM	39	69%	52%	100%	7.7%	78%(79%)	22%(32%)
TP	45	74%	80%	98%	0%	85%(80%)	15%(38%)

where, *successful* is the percentage of corresponded links which fulfil rule 3, *no name* is the percentage of subjects who sent no links and *%3,4(corresp)* is the percentage of sent links with strength 3 or 4 (from those, the percentage of corresponded links).

Observe that the percentage of corresponded links in both treatments is very similar.

Although there is a considerable difference in the percentage of exact links, observe that results referring to *successful* variable are not so different for both treatments. Thus, the accuracy of the strength in corresponded links is not perfect in the TM, but very high, given that the difference in strength in all corresponded links is at most 1.

Monetary rewards have not a strong effect in the choice of the $(00, 00)$ equilibrium since the percentage of subject with 0 links in this treatment is only 7.7%.

Finally, table 3 shows that the percentage of friend and acquaintance relationships is very similar in both treatments (78% vs 85% for friends and the complementary for acquaintances), as well as the correspondence percentage

(79% vs 80% for friends and 32% vs 38% for acquaintances). Hence, our mechanism captures mainly strong relationships. In sum,

i) previous results suggest that subjects are going to name other individuals and they are not going to assure their prize naming nobody and

ii) the NEM captures strong relations among subjects.

In section 4 we develop a model which explains subjects' behavior.

A simple model for the NEM

In this section, we develop a theoretical analysis with the aim of shedding light on the results obtained in previous section. In particular, we are interested in exploring the following result. Despite the fact that subjects earn the prize for sure if they say they have no friends, nobody played its weakly dominant strategy in TP[48]. Hence their preferences may depend not only on material payoffs but also on other considerations.

The induced game by NEM may be formally defined as a 3-tuple $\Gamma = \left\{N, \{s_i\}_{i\in N}, u_i\left(\pi_i\left(s_i, s_{-i}\right), \mu_i^{s_j}\right)\right\}$, where N is the set of participants in the experiment, $s_i = \{s_{ij}\}_{i\neq j}$ is the strategy (strength) of individual i respect to the ij relationship, $\mu_i^{s_i}$ is the probability assigned by player i to the first order beliefs of player j about the strategy s_i and, $u_i\left(\pi_i\left(s_i, s_{-i}\right)\right)$ is the utility associated to the outcome of individual i when he plays s_{ij} and the individual he named (j) plays s_{ji}.

Let us define r_{ij} as the real strength of the relationship between subjects i

[48] In TM only 7.7% of the individuals played this weakly dominant strategy.

and j which is perceived by player i.

Our surprising results (with particular reference to the absence of subjects not naming anybody in TP) suggests that subjects preferences regard not only for their own material payoffs but also for their friends payoff. As stated in Geanokoplos et al. [12]:

> "The traditional theory of games is not well suited to the analysis of belief dependent psychological considerations as surprise, confidence, gratitude, disappointment, embarrassment and so on".

A behavioral model which introduces these considerations (defined in the literature as *belief-dependent motivations*) is the Fairness Theory of Rabin [21]. A modified version setting applied to the NEM could be useful to analyze theoretically the reasons for subjects hardly never playing a weakly dominant strategy in traditional game theory. In particularly, it can be shown that applying this model and the "guilt aversion" concept defined by Charness and Dufwenberg [8], the only efficient equilibria coincide with the ones more frequently elicited by the NEM, whenever the weight of belief-dependent motivations in subjects' utility function is sufficiently large. Although no naming any friend is still an equilibrium, under certain conditions is not efficient.

Let us define the utility function of individuals as follows:

$$u_i\left(\bar{s}_{ij}, \bar{s}_{ji}, \mu_i^{s_i}\right) = \pi_i\left(\bar{s}_{ij}, \bar{s}_{ji}\right) + \theta_i^{r_{ij}} \Psi_i\left(\bar{s}_{ij}, \bar{s}_{ji}, \mu_i^{s_i}\right)$$

, where $\pi_i(\bar{s}_{ij}, \bar{s}_{ji})$ are the material payoffs corresponded to the payoff table described in figure 1, and $\Psi_i(\bar{s}_{ij}, \bar{s}_{ji}, \mu_i^{s_i})$ represents the psychological payoffs which are weighted with a parameter $\theta_i^{r_{ij}}$ which depends on the real relationship between i and j perceived by i; in fact, it may be assumed to be increasing in r_{ij}. Ψ_i can be decomposed into two terms:

$$\Psi_i(\bar{s}_{ij}, \bar{s}_{ji}, \mu_i^{s_i}) = k_i(\bar{s}_{ij}, \bar{s}_{ji}) - g_i(\bar{s}_{ij}, \bar{s}_{ji}, \mu_i^{s_i})$$

, where $k_i(\bar{s}_{ij}, \bar{s}_{ji})$ represents a modified "kindness" function of the one developed by Rabin (1993), and $g_i(\bar{s}_{ij}, \bar{s}_{ji}, \mu_i^{s_i})$ represents the guilt aversion[49] of subject i. Those functions are defined as follows:

$$\begin{aligned} k_i(\bar{s}_{ij}, \bar{s}_{ji}) &= [1 + (\pi_i(\tilde{s}_{ij}, \bar{s}_{ji}) - \pi_i(\bar{s}_{ij}, \bar{s}_{ji}))][\pi_j(\bar{s}_{ij}, \bar{s}_{ji}) - \pi_j(\tilde{s}_{ij}, \bar{s}_{ji})] \\ \tilde{s}_{ij} &\in \begin{array}{ll} \arg\min\limits_{s_{ij}} & \pi_j(s_{ij}, \bar{s}_{ji}) \\ s.a. & \pi_i(\bar{s}_{ij}, \bar{s}_{ji}) \leq \pi_i(s_{ij}, \bar{s}_{ji}) \end{array} \end{aligned}$$

$$\begin{aligned} g_i(\bar{s}_{ij}, \bar{s}_{ji}, \mu_i^{s_i}) &= \sum_{s_i \in \check{S}_{ij}} (\mu_i^{s_i}[\pi_j(s_{ij}, \bar{s}_{ji}) - \pi_j(\bar{s}_{ij}, \bar{s}_{ji})]) \\ \check{S}_{ij} &= \left\{ s_{ij} \;\middle|\; s_{ij} \in \begin{array}{ll} \arg\max\limits_{s_i} & \pi_j(s_{ij}, \bar{s}_{ji}) \\ s.a. & \pi_i(\bar{s}_{ij}, \bar{s}_{ji}) \leq \pi_i(s_{ij}, \bar{s}_{ji}) \end{array} \right\} \end{aligned}$$

[49] Recall that this term is taken from Charness and Dufwenberg [8] and we adapt it to our framework. Charness et al. concept is based on the idea that "a decision-maker suffers from guilt to the extent he believes he hurts others relative to what others believe he will do, and he tends to avoid such choices".

The kindness function of subject i is composed by two terms. The second term compares: i) j's payoffs with i's current strategy $(\pi_j(\bar{s}_{ij}, \bar{s}_{ji}))$ to ii) j's payoffs when i tries to minimize them $(\pi_j(\tilde{s}_{ij}, \bar{s}_{ji}))$, whenever i maintains or increases his current payoffs.

The first term takes into account how much payoff is sacrificing player i. This term will be 1 when subject i does not sacrifice her own payoffs in order to not decrease j's payoffs. This term is strictly higher than 1 only in case subject i must sacrifice his current payoff for not reducing j's payoffs.

To sum up, an individual i will feel that she is being "kind" to subject j if she is not reducing j's payoffs maintaining her own payoffs. Player i's sense of kindness will be higher when she is also sacrificing her own payoffs trying to avoid reducing j's payoffs[50].

The guilt aversion function tries to capture a situation where a subject feels guilty because he decreases another subject's payoffs. Here, we consider the guilt in a strong way given that to compute it, subject i compares what subject j obtains with i 's current strategy, $\bar{s}_i$ and what it would be the maximum payoff of j if i would favor j utmost. That is, the guilt is given by the difference between the payoffs player j could obtain if player i tried to maximize them and the payoffs player j obtain with the current player i's strategy. This difference is pondered by player i second order beliefs, i.e, the probability that i thinks that player j assigns to player i playing a strategy which maximizes j's payoffs.

[50] This function can be defined different depending on the reference point, but in our setting as material payoffs are or 1 or 0, most of them are analogous. This is also true for the guilty aversion function.

These functions should be normalized but in our setting this is not necessary given that payoffs are always 0 or 1.

In order to simplify the analysis we formulate the following assumptions:

Assumption 1: *There is Common Knowledge between any subjects i and j, on the game in which they are enrolled, a reduced form of the game is represented in figure 1 (page 105).*

Assumption 2: *Each subject has only psychological considerations over other individuals payoffs on the part of material payoffs which directly depends on himself.*

This implies that at the moment of computing the psychological payoffs of individual i when naming subject j, he considers that the random selected link is the link ij. That is, player i is not going to introduce in his psychological payoffs (respect to individual j) considerations about the strategies that other players are playing with individual j.

In figure 5 we compute payoffs according to utility function defined above of any two subjects i and j in N.

The Nash equilibria in pure strategies in the 2-player reduced NEM game remain:

$$NE_2^{'} = \{(0,0),\ (1,1),\ (1,2),\ (2,1),\ (2,2),\ (2,3),\ (3,2),\ (3,3),\ (3,4),\ (4,3),\ (4,4)\}.$$

However, the main difference within this model is that if the condition $1 < 1 + \theta_k^{r_{kh}}$ holds $\forall k \neq h$, then $(0,0)$ is not an efficient equilibrium. And therefore,

the equilibrium in which every subject doesn't name anybody is not an efficient equilibrium in the n-player NEM game. This could be a possible explanation why no subject play this equilibrium in TP treatment and very few people in the TM treatment.

Figure 5: UTILITY TABLE

$i \setminus j$	0	1	2	3	4
0	1 1	1 $1-\theta_i^{r_{ij}}\mu_i^1$	1 $1-\theta_i^{r_{ij}}\mu_i^2$	1 $1-\theta_i^{r_{ij}}\mu_i^3$	1 $1-\theta_i^{r_{ij}}\mu_i^4$
1	$1-\theta_j^{r_{ij}}\mu_j^1$ 1	$1+\theta_j^{r_{ij}}$ $1+\theta_i^{r_{ij}}$	$1+\theta_j^{r_{ij}}$ 1	$1-\theta_j^{r_{ij}}\mu_j^3$ $1-\theta_i^{r_{ij}}\mu_i^3$	$1-\theta_j^{r_{ij}}\mu_j^4$ $1-\theta_i^{r_{ij}}\mu_i^4$
2	$1-\theta_j^{r_{ij}}\mu_j^2$ 1	$1+\theta_j^{r_{ij}}$ $1+\theta_i^{r_{ij}}$	$1+\theta_j^{r_{ij}}$ $1+\theta_i^{r_{ij}}$	$1+\theta_j^{r_{ij}}$ $1+\theta_i^{r_{ij}}$	$1-\theta_j^{r_{ij}}\mu_j^4$ $1-\theta_i^{r_{ij}}\mu_i^4$
3	$1-\theta_j^{r_{ij}}\mu_j^3$ 1	$1-\theta_j^{r_{ij}}\mu_j^1$ $1-\theta_i^{r_{ij}}\mu_i^1$	$1+\theta_j^{r_{ij}}$ $1+\theta_i^{r_{ij}}$	$1+\theta_j^{r_{ij}}$ $1+\theta_i^{r_{ij}}$	$1+\theta_j^{r_{ij}}$ $1+\theta_i^{r_{ij}}$
4	$1-\theta_j^{r_{ij}}\mu_j^4$ 1	$1-\theta_j^{r_{ij}}\mu_j^1$ $1-\theta_i^{r_{ij}}\mu_i^1$	$1-\theta_j^{r_{ij}}\mu_j^2$ $1-\theta_i^{r_{ij}}\mu_i^2$	$1+\theta_j^{r_{ij}}$ $1+\theta_i^{r_{ij}}$	$1+\theta_j^{r_{ij}}$ $1+\theta_i^{r_{ij}}$

Conclusions

Recent literature highlights the importance of obtaining the architecture of social interactions underlying subjects. This paper provides an innovative mechanism to elicit social networks.

In this mechanism friends and acquaintances are costly in the sense that subjects have the probability of losing the payoff when they name a friend or acquaintance under some preferences.

We have conducted three different treatments which differ in the type of incentive. The first two were based on credit points and monetary awards. They display very similar results, which indicates that the NEM is robust to changes in awards. The last one was the baseline and was run with no incentives at all. Its results decidedly support the necessity of a mechanism to elicit social networks, given the pretty reduced percentage of correspondence of 5%.

The main difference between our mechanism and the previous ones (MRQ) is that the NEM provides very low incentives to name a lot of people given that if subjects do not name anybody, they assure the maximum payoff (note that we introduced this rule in the mechanism in order to provide an "exit" option for those subjects with no friends or reluctant to reveal their private information). In each decision subjects take respect to a friend or an acquaintance, they are aware about the risk of loosing a sure payoff. Therefore, all relationships captured by this mechanism are true friends (recall that the probability of a random coordination is close to zero and the percentage of corresponded links is 70% and 75% for TM and TP respectively) but it might be friends that

are not elicited by our device. Even if this is the case, we are achieving our goal: assuring true friendship relations by penalizing mistakes in coordination when naming friends. In future research, we want to study other experimental problems where the friendship relations are relevant , so we can extract a sample of true friends from our network and control the "friend" variable, for a more accurate analysis of the problem.

The most surprising result is that there is no subject (in the treatment where rewards were credit points) or very few subjects (7.7% in monetary rewards treatment) who reveal no link despite of this being a weakly dominant strategy. It is important to note that this result is not due to the fact that individuals feel ashamed to say they have no friends. The reason is that all subjects are corresponded "exactly" (with no difference in strength) by at least one subject and we have already explained that the probability that this coordination happens at random is negligible.

The latter results suggest that subjects preferences regard not only for their own material payoffs but also for their friends payoff. Thus, in an attempt to explain those results, we develop a behavioral model which introduces other considerations denominated *belief-dependent motivations* in the literature. We combine the concept of "kindness" from the Fairness Theory of Rabin [21] and the notion of "guilt aversion" from Charness et al. [8]. This setting is adapted to our NEM to analyze theoretically the reasons for subjects never playing a weakly dominant strategy in traditional game theory. In particularly, it can be shown that the only efficient equilibria coincides with the ones more frequently

elicited by the NEM, whenever the weight of belief-dependent motivations in subjects' utility function is sufficiently large. Although, no revealing any link is still an equilibrium, under this setting it is not efficient.

Finally, remark that the main result of our mechanism is that a significant percentage of $70\% - 75\%$ of the links were corresponded (names and surnames) and, from those nearly 100% display a quite accurate strength (difference in strength 1 or lower). The correspondence obtained by NEM doubles previous experimental evidence (MQR). These results let us think that our network captures most of the relationships among individuals.

References

[1] Berninghaus, S.K., Ehrhart, K.M., and Keser, C. "Conventions and Local Interaction Structures: Experimental Evidence", *Games and Economic Behavior*, **39**, 177-205, 2002.

[2] Bloch, F. "Coalitions and Networks in Industrial Organization" *Mimeo: GREQAM,* 2001.

[3] Brañas-Garza, P., Durán, M. A. and Espinosa, M. P. "Do experimental subjects favor their friends?". *ThE Papers 05/14, Department of Economic Theory and Economic History of the University of Granada*, 2005.

[4] Callander, S. and Plott, C.R. "Networks: An Experimental Study". *Mimeo, Northwestern University.* 2003.

[5] Calvó-Armengol, A. and Jackson, M.O. "Networks in Labor Markets: Wage and Employment Dynamics and Inequality," *Mimeo: Caltech and Universitat Autònoma de Barcelona* (2001).

[6] Cassar, A. "Coordination and Cooperation in Local, Random and Small World Networks: Experimental Evidence". *North American Summer Meetings of the Econometric Society: Game Theory*, 2002.

[7] Charness, G., Corominas-Bosch, M., and Frechette, G.R. "Bargaining and Network Structure: An Experiment". forthcoming in *Journal of Economic Theory.*

[8] Charness, G. and Dufwenberg, M. "Promises and Partnership". *Mimeo, University of California, Santa Barbara.* 2003.

[9] Corbae, D. and Duffy, J. "Experiments with Network Economies". *Mimeo, University of Pittsburgh.* 2002.

[10] Deck, C. and Johnson, C. "Link Bidding in a Laboratory Experiment". *Mimeo, University of Arkansas.* 2002.

[11] Falk, A. and Kosfeld, M. "It's all about Connections: Evidence on Network Formation". *Mimeo, University of Zurich.* 2003.

[12] Geanokoplos, J., Pearce, D. and Stacchetti, E. : "Psychological Games and Sequential Rationality," *Games and Economic Behavior*, 1, 60-79, 1989.

[13] Goyal, S. and Moraga, J.L. "R and D Networks," *Rand Journal of Economics*, 32, 686-707, 2001.

[14] Granovetter, M. "Getting a Job: A Study of Contacts and Careers", 2nd edition, *University of Chicago Press*, Chicago, [1974], 1995.

[15] Jackson, M. O. "A Survey of Models of Network Formation: Stability and Efficiency". Chapter1 in *Group Formation in Economics; Networks, Clubs and Coalitions*, Cambridge University Press, Cambridge U.K., 2004.

[16] Keser, C., Ehrhart, K.M. and Berninghaus, S.K. "Coordination and Local Interaction: Experimental Evidence". *Economics Letters*, **58**, 269-275, 1998.

[17] Kirchkamp, O. and Nagel, R. "Local and Group Interaction in Prisoners' Dilemmas". *Mimeo, University of Mannheim.* 2001.

[18] Kranton, R. and Minehart, D. "A Theory of Buyer-Seller Networks," *American Economic Review*, 91(3), 485-508, 2002.

[19] Mobius, M., Rosenblat, T. and Quoc-Anh, D. "Social Capital in Social Networks" (manuscript in preparation). *Mimeo*, 2005.

[20] Montgomery, J. "Social Networks and Labor Market Outcomes," *The American Economic Review*, 81, 1408–1418, 1991.

[21] Rabin, M. : "Incorporating Fairness into Game Theory and Economics,"*American Economic Review*, 83, 1281-1302, 1993

[22] Reuben,E. and van Winden, F. "Reciprocity and Emotions when Reciprocators Know Each Other". *Discussion paper 04-098. Tinbergen Institute,* 2004.

[23] Reuben, E. and van Winden, F. "Social Ties and Coordination on Negative Reciprocity: The Role of Affect". *Discussion paper 04-098. Tinbergen Institute*, 2006.

[24] Riedl, A. and Ule, A. "Exclusion and Cooperation in Social Network Experiments". *Mimeo, University of Amsterdam.* 2002

[25] Vanin, P. "Network Formation in the Lab: A Pilot Experiment". *Mimeo, Universitat Pompeu Fabra.* 2002.

[26] Wang, P. and Watts, A. "Formation of Buyer-Seller Trade Networks in a Quality-Differentiated Product Market," *Mimeo: Penn State University and Southern Illinois University,* 2002.

Appendix 1

INSTRUCTIONS[51]

Hello, now you're going to take part in an Economic Experiment. We thank you in advance for your collaboration. This is part of a project coordinated by a teacher from the University of Alicante and he asks you for your collaboration to carry it out. The aim of this Experiment is studying how individuals take their decisions in certain environments. The instructions are simple.

If you follow them carefully, you will receive an additional POINT IN THE FINAL MARK OF MICROECONOMICS II [AMOUNT OF MONEY] confidentially at the end of the experiment.

You can ask the queries you may have at any time, raising your hand but without speaking. Except for these questions, any kind of communication between you is forbidden and subject to your expulsion from the Experiment.

Please, write a list with the name and surname of all you friends from the class. After their names, you have to write a number:

1 if you hardly know him/her; 2 He/she is only someone you know; 3 if he/she is your friend; 4 if he/she is a very close friend.

¿How do I GET THE POINT [RECEIVE THE MONEY]? We take your list and take out randomly the name of one (only one) of your friends (the ones you have mentioned); then, we look at your friend's list and see whether:

i) he/she has mentioned you and

ii) he/she has scored you with a similar number to the one you have rated

[51] In CAPITAL are highlighted differences between TP and TM (TM in brackets).

him/her (this means a maximum difference of one point).

If i) and ii) are affirmative you win THE POINT [5€]. If i) or ii) fails, then you win nothing (0 POINT [0€]).

Example. My List is:

Jose Pérez with a 3.

Juan Martínez with a 4.

Emilio López with a 1.

Jose Antonio Rodríguez with a 2.

Randomly, José Pérez was chosen from my list. They then looked at his list and he had rated me with a 4. As the difference in the scoring was just one point, I win THE POINT FOR MICROECONOMICS II [5€]. If I had rated him with 2 points, I would have won nothing.

NOTICE 1. If you mention no-one, you also receive THE POINT FOR MICROECONOMICS II [5€].

NOTICE 2. (about the notice above). Be aware that if you mention no-one but someone mentions you, you will be prejudicing him or her. In other words, a friend who mentions you would not receive THE POINT FOR MICROECONOMICS II [5€] because you don't include him/her in your friends' list[52].

[52] For the TNI treatment, instructions were as follows:

Hello, now you're going to take part in an Economic Experiment. We thank you in advance for your collaboration. This is part of a project coordinated by a teacher from the University of Alicante and he asks you for your collaboration to carry it out. The aim of this Experiment is studying how individuals take their decisions in certain environments. The instructions are simple.

You can ask the queries you may have at any time, raising your hand but without speaking. Except for these questions, any kind of communication between you is forbidden and subject to your expulsion from the Experiment.

Appendix 2

Proposition 1 A strategy $\mathbf{s}^* = (\mathbf{s}_1^*; \mathbf{s}_2^*; ...; \mathbf{s}_n^*) \in \prod_{i \in N} S_i$ is a pure Nash equilibrium of the NEM game if and only if $\left(s_{ij}^*, s_{ji}^*\right)$ is a pure Nash equilibrium of each of the 2-player Reduced NEM games for any pairs of players (i, j) in N.

Proof of Proposition 1:.

For the if part, first suppose that $\mathbf{s}^* = (\mathbf{s}_1^*; \mathbf{s}_2^*; ...; \mathbf{s}_n^*)$ is a pure Nash equilibrium for the NEM game. Then, it satisfies:

i) $\mathbf{s}^* = (\mathbf{s}_1^*; \mathbf{s}_2^*; ...; \mathbf{s}_n^*) \in \prod_{i \in N} S_i$

ii) $\pi_i \left(\mathbf{s}_i^*; \mathbf{s}_{-i}^*\right) \geq \pi_i \left(\mathbf{s}_i; \mathbf{s}_{-i}^*\right)$, $\forall \mathbf{s}_i \in S_i$, and $\forall i \in N$.

For the structure of the game (only one link, $s_{ij} > 0 \leftrightarrow j \in J_i$, is randomly checked for each subject in N), payoffs can be considered in expected terms. So condition *ii)* becomes:

ii)$'$ $\pi_i^e \left(\mathbf{s}_i^*; \mathbf{s}_{-i}^*\right) \geq \pi_i^e \left(\mathbf{s}_i; \mathbf{s}_{-i}^*\right)$, $\forall \mathbf{s}_i \in S_i$, and $\forall i \in N$.

According to the rules explained in section NEM (see page 102), *ii)*$'$ can be developed as follows.

Case 1 $\exists j \in N \left| s_{ij}^* > 0 \right.$

Please, write a list with the name and surname of all you friends from the class. After their names, you have to write a number:

1 if you hardly know him/her; 2 He/she is only someone you know; 3 if he/she is your friend; 4 if he/she is a very close friend.

Thank you very much.

Case 5

iii) $\sum_{j\in J_i^*} \frac{1}{j_i^*}\pi_i\left(s_{ij}^*, s_{ji}^*\right) \geq \sum_{j\in J_i} \frac{1}{j_i}\pi_i\left(s_{ij}, s_{ji}^*\right),\ \forall s_{ij} \in \{1,2,3,4\},\ \forall j \in J_i$ *and* $\forall i \neq j \in N$.

Note that we have previously denoted $J_i = \{j \in N \setminus \{i\} \mid s_{ij} > 0\}$, $j_i = |J_i|$, $J_i^* = \{j \in N \setminus \{i\} \mid s_{ij}^* > 0\}$ *and* $j_i^* = |J_i^*|$.

Another feature which can be deduced from the particular structure of the NEM n-player game is that in all pure equilibria all subjects must obtain payoffs equal to 1 (if not, it is because they have obtained 0 payoff, so the have incentives to deviate). Hence, it is satisfied that:

iv) $\pi_i\left(s_{ij}^*, s_{ji}^*\right) = 1, \forall s_{ij}^* \in \{1,2,3,4\}, \forall s_{ji}^* \in \{0,1,2,3,4\}\ \forall j \in J_i$ *and* $\forall \{i,j\} \in N,\ i \neq j$.

In addition, it can be considered that when $s_{ij}^* = 0$, $\pi_i\left(s_{ij}^*, s_{ji}^*\right) = 1$, *given that if a subject doesn't name anybody she obtained 1 for sure.*

Finally, it is directly from iv) and the previous consideration that the following conditions hold:

v) $\pi_i\left(s_{ij}^*, s_{ji}^*\right) \geq \pi_i\left(s_{ij}, s_{ji}^*\right), \forall s_{ij} \in \{0,1,2,3,4\}$ *and* $\forall \{i,j\} \in N,\ i \neq j$.

Thus, it have been proved that $\left(s_{ij}^*, s_{ji}^*\right)$ *is also an equilibrium in pure strategies for any pair* (i,j) *of subjects in* N *of the* 2*-player game represented in figure 1 (see page 105).*

Case 2 $s_{ij}^* = 0, \forall j \in N,\ j \neq i$.

Case 6 *In this case it is trivial that if each subject* i *in* N *doesn't name anybody, those strategies also constitute an equilibrium for the* 2*-player Reduced NEM game.*

For the only if part, suppose that $\left(s_{ij}^*, s_{ji}^*\right)$ is an equilibrium in pure strategies for any pair (i, j) of subjects in N of the 2-player Reduced NEM game (figure 1). Then, by definition:

i) $\pi_i\left(s_{ij}^*, s_{ji}^*\right) \geq \pi_i\left(s_{ij}, s_{ji}^*\right), \forall s_{ij} \in \{0,1,2,3,4\}$ and $\forall\{i,j\} \in N$, $i \neq j$.

With an analogous reasoning as in the if part, it can be deduced that:

ii) $\pi_i\left(s_{ij}^*, s_{ji}^*\right) = 1$, $\forall s_{ij}^* \in \{0,1,2,3,4\}$, $\forall j \in J_i$ and $\forall\{i,j\} \in N$, $i \neq j$.

Case 1 $\exists j \in N \left| s_{ij}^* > 0 \right.$

Case 7 *From ii) it can be computed the payoff for the NEM n-player game in equilibrium:*

iii) $\sum_{j \in J_i^*} \frac{1}{j_i^*} \pi_i\left(s_{ij}^*, s_{ji}^*\right) = 1$, $\forall s_{ij} \in \{1,2,3,4\}$, $\forall j \in J_i$ *and* $\forall i \neq j \in N$.

Finally, given that payoffs in the NEM n-player game can take only two values: 0 *or* 1*, it is clear that a convex combination of payoffs is always lower or equal to* 1*, and hence the equilibrium conditions hold:*

iv) $\sum_{j \in J_i^*} \frac{1}{j_i^*} \pi_i\left(s_{ij}^*, s_{ji}^*\right) \geq \sum_{j \in J_i} \frac{1}{j_i} \pi_i\left(s_{ij}, s_{ji}^*\right)$, $\forall s_{ij} \in \{1,2,3,4\}$, $\forall j \in J_i$ *and* $\forall i \neq j \in N$.

Case 2 $s_{ij}^* = 0$, $\forall j \in N$, $j \neq i$.

Case 8 *In this case it is trivial that if each subject i in N doesn't name anybody in each of the 2-player Reduced NEM games, those strategies also constitute an equilibrium for the n-player NEM game.*

■

Social foundations of altruism: a note

Introduction

Although there exists a growing experimental literature about the role of socialization on altruistic behavior (see for example Hoffman et al.[11], Bohnet & Frey [2], Eckel & Grossman [9] or Charness & Gneezy [8]), there are only a few papers that study the relationship between social networks and altruism.

As far as we know, there are two experimental papers dealing with social networks and giving. The seminal paper is done by Markus Mobius, Tanya Rosenblat & Do Quoc-An [12] (MRQ hereafter). This paper studies the portion of the pie the dictator shares with a recipient. They check if altruism varies when the dictator faces a direct friend, an indirect one or if the dictator faces an stranger. Also they control (in other treatment) the chance of ex-post punishment when recipients know who the dictator is. Results clearly probe the argument previously supported by Hoffman *et al.* [11]: *the larger social distance the smaller giving.*

MRQ also analyze the effect of inter–individuals links on giving. To do so, they define a network measure named *strength* which captures the number of common friends the allocator and the recipient share[53]. They show that the larger strength the smaller the pie portion dictators keep. In sum, MRQ shows that *the higher integration the larger giving.*

However there is a potential problem in MRQ setting because dictators know

[53] Although this index is a related measure of clustering is, in fact,different. Clustering is defined properly as the number of friends of a given subject that are friends among them.

that their partners are friends but also they know the identity of their friends then, there are three effects rather than just only one: *i*) the friendship relation, *ii*) each dictator knows his friends identity and then he knows more information about the recipient (see for example Brañas-Garza [6] for the effects of recipient's attributes on donations) and *iii*) positive reciprocity, dictators may ex-post reveal recipients what "generously" they did[54].

The second paper done by Pablo Brañas-Garza, Miguel Durán and Maripaz Espinosa [3] (BDE hereafter) partially solves the problem. They asked subjects (using a different device than MRQ) his close friends, and then, after elicit the whole social network they inform dictators that they will play with *a direct friend* but *they don't say who.* In fact they are informed that they will play with any randomly chosen close–friend[55]. The baseline treatment comprises dictators playing with strangers (individual not directly linked with dictators). Interestingly, results are very similar: although *dictators do not know the identity of the recipient – they just know they are friends – they favour their friends.*

Hence, previous results indicate that there is a positive correlation between SOCIAL NETWORKING and GIVING. As we noted before, its surprising that no any paper uses standard network measures to explore giving. We will do in this research. Then this paper adds to the literature in two ways: *i*) using standard measures of networking we show that both *clustering* and *degree-out* affect dictator giving; *ii*) In contrast to MRQ and BDE this paper provides

[54] Brañas-Barza&Espinosa [4] show that, once a subject has named at least one friend, reciprocity is decreasing in the number of friends a subject names.

[55] This game coincides with MRQ for the case of subjects that named only one friend.

a different setting, an environment where the dictator faces several recipients but only a percentage of them are friends. We show that when dictator faces friends with certain positive probability ($0 \leq p < 1$) then, *part of the social effect vanishes.*

Our results arise from data generated in two separate experiments: a dictator game with 40 allocators and a network coordination game (a variation of the MRQ device) played by the same individuals 3 months later. We give evidence for both results (probability of matching a friend and networking effects) in two kinds of networks, one which contains only friends (labeled as small network) and one which contains friends and acquaintances (labeled as large network).

The rest of the paper is organized as follows. Next section explore both experiments and its basic features. Section 3 shows and discusses results and the last concludes.

Experimental Data

This paper merges data arising from two experiments: a coordination game to elicit social network (Brañas-Garza, Cobo-Reyes, Jiménez & Ponti [1], BCJP hereafter) and a single–room dictator game where dictators and recipients saw each others (Brañas-Garza [5], BG hereafter). Next sections shortly explain each one.

BCJP: The coordination game

BCJP proposes an incentive-based mechanism to obtain the set of social connections. The main argument to justify the design and performance of this experiment is obvious: People may not be willing to reveal private information (such as friends) since they might be aware of any negative consequence in the use of this information[56]. This mechanism tries to overcome this problem through a set of incentives.

BCJP asked subjects to reveal the name (and surname) of their friends and subjects were also invited to define how they value the relationship. They would label each of their friends as just acquaintances (strength[57], s_{ij}= 1, 2) or friends (s_{ij}= 3, 4) and $s_{ij} = 0$ denotes the situation in which these subjects are not connected (there exists no link between i and j). Individuals were offered a fixed prize if they fill: *i*) *Rule 1:* Subjects name each other. *ii*) *Rule 2:* His friendship score is also accurate, that is, the difference in the scores given by each individual is not higher than 1; *iii*) To decrease the punishment size (that is, to relax rule 1 and 2) individuals were informed that (*Rule 3*) from the whole set of names given by any subject only one, randomly chosen, would be checked. *iv*) *Rule 4:* Subjects were completely allowed to not write any name and, doing so they would earn the prize for sure. However they were warned that doing so they would damage their friends.

[56] Results provided in BCJP show that, without mechanism, the percentage of bidirectional links obtained is only 4.5% against 75% of bidirectional links obtained with the proposed mechanism.

[57] Strength is denoted by s_{ij} and is defined as the score given by i to the ij relationship. $s_{ij} = 1$: j is an acquaintance of i; $s_{ij} = 2$: j is a close acquaintance of i; $s_{ij} = 3$: j is a friend of i; $s_{ij} = 4$: j is a close friend of i.

BCJP explores networks using monetary and grade–points rewards and non–incentives networks (without any prize). We will focus on one of those networks (the one with grade points, called *NET I*) because the individuals who played the dictator game precisely belongs to this network[58]. This classroom network connects 50 first year student of Business at Jaen University, southern Spain. These subjects sent a total number of 289 links: 76% (220) where corresponded, that is Peter call John and vice versa, and 180 were corresponded with identical strength. The majority of the links were for friends (85%) and only 15% were for acquaintances. On average each subject sent 4.49 links (modal value was 4) and nobody sent 0 links.

BG: the act of giving

BG uses the dictator game to elicit subject altruism. BG experiment comprises two experimental settings: classroom (BGClass) and regular (BGeX) experiments. Those subjects who participated in both the network (NET I) and the dictator game belong to the BGClass. This experiment main features are: *i*) to reduce subject doubts about the game (see Frohlich, Oppenhaimer & Moore [10]) BGClass uses a single–room DG. Then, all the subjects are placed in the same room. 80 students were placed in within a big room in four columns. Those 40 subjects who had participated in the network game where placed in column 1 and 3 and they were invited to play a dictator game with the columns 2 and 4 (recipients). Dictators were informed that they would play the game

[58] BCJP show that results of the monetary incentives treatment are very similar to the ones in the grade points treatment.

with one (randomly selected) of those 10 subjects placed on his left (column-2 for c-1 dictators and c-4 for c-3 dictators). Hence, dictators saw recipients and in consequence they did not doubt about recipients existence. *ii*) BG uses *framed* instructions in 20 (up to 40) subjects. Framed in the sense that they were explicitly invited to share the pie. This moral framing consists of additional sentences saying "the recipient relies on you" or "they performed they same task previously". The later estimation will control it through dummy variables. *iii*) Other: BGClass uses 10 ECU[59] and single anonymity vs. double–blind (thus, students assignments were known by the experimentalist but unknown by participants).

Note that later point *i*) is not trivial at all. If *dictators see recipients* then, they may calculate the probability of sending his money to any close friend and it could has an effect of the donation. Interestingly, *our network let us to check it.*

Results

To analyze the network provided by BCJP we use standard network measures (see, for example Vega-Redondo [13]): Clustering is the number of friends of a selected subject who are friends among them and, finally, Degree is the number of links sent or received by a node [degree–in (out) is the number of

[59] Experimental Currency Unit that would be transformed in extra–credit points in the final grade of Microeconomics I. Note that the maximum compensation would be the 5% of the final grade. BG [5] compares the effect of monetary versus points rewards (BGClass vs. BGeX) showing that students are much more competitive (20% larger approx.) when the use points instead of money.

links received (sent)].[60] Table 1 shows the most indicative descriptive statistics of the above attributes[61].

Table 1: Network Players Attributes

		Mean	Max.	Min.	Mode	var.
NET I	Clustering	0.44	0.85	0.00	0.50	0.04
	Degree-in	0.09	0.14	0.01	0.09	0.00
	Betweenness	0.04	0.23	0.00	0.04	0.00
	Degree-out	0.09	0.18	0.02	0.12	0.00

Now we explore *how subject social integration may affect his dictatorial donations*. We conjectured that social integration may affect giving, in the sense than socialization increases subjects willingness to cooperate even with anonymous partners. We use degree-out as a measure of how individuals perceive their own social integration. Clustering may reinforces such a socialization process in the sense that your friends are also friend between them (how close is the society where subjects live).

[60] Another measures are the Betweenness: accounts for the centrality of a selected node in the network and the Diameter which is the maximal geodesic distance across nodes which are connected by a network path, i.e., the diameter tell us the maximum number of steps between any two nodes in the network. Observe that this measure refers to the net not to a particular subject. NET I has a diameter equal to 9.

[61] Note that all measures are normalized to 1. *Degree-out* is computed as $\frac{nls_i}{n-1}$ where nls_i is the number of links sent by subject i and n is the number of subjects in the network. *Degree-in* is computed in an analogous way. *Clustering* is computed as $\frac{nlf_i}{nlpf_i}$ where nlf_i is the number of links among the friends and acquaintances of subject i and $nlpf_i$ is the number of all possible links among the friends and acquaintances of subject i.

We are going to distinguish between two different samples: *i*) the network including all the possible relations among individuals (strength from 1 to 4), hereafter LARGE-SAMPLE and *ii*) the network considering only friendship relations (strength 3 or 4), hereafter called SMALL-SAMPLE. Figure 1 illustrates the whole network (including all types of links).

We use both samples (small and large network) to perform an study of the effect of the probability of any recipient being a dictator's friend, *degree-out* and *clustering on generosity*.

Recall that BDE show that dictator giving is higher when the allocator match with "non–identified" friends versus a strangers. Similar results are shown by MRQ using dictators matched with "identified" friends (also its positively correlated with their measure of common friends). Our *one-room design* let us to check a *new possibility*: a dictator matching with an identified friend but only with a certain probability. We define this variable as:

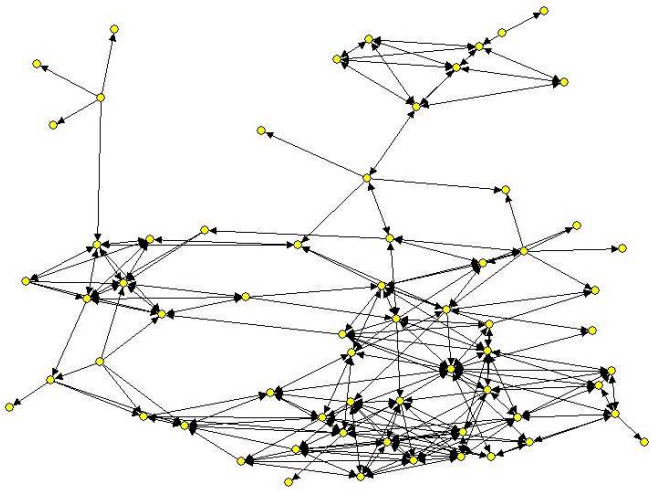
Relation (r): it is the probability of any recipient being a dictator's friend or acquaintance ($0 \leq r_i \leq 1$).

Thus, the question is, does friendship effect prevail under uncertainty? Our network let us to identify the number of friends each dictator faces as potential recipients.

Column 1 in table 2a shows that dictator/recipient relationship (r_i) does not affect dictator giving. Also, this result does not change if we just consider the sample of friends (see column 1 in table 2b). Summarizing:

Result 1: *When the dictator matchs a friend with a certain probability, then this relationship does not affect giving.*

Figure 1: DIRECTED GRAPH OF NET I



Now we use the standard network measurements provided by the literature. In the following we analyze both the DEGREE-OUT and CLUSTERING[62]. Table 2a summarizes the estimations of the above variables using the *large*–sample. The dependent variable is the dictator giving and *dum* is the dummy which captures the framing effect (see item *ii*) in page 139).

[62] We have also done regressions which include *betweenness* as an explanatory variable but in all of them it was not statistically significant.

Table 2: Tobit estimation

a) for the Large-Sample

	probability	clustering		degree-out	
	(1)	(2a)	(2b)	(3a)	(3b)
c	**0.4**(0.11)	-0.12(0.16)	—	-0.05(0.18)	—
dum	**0.43**(0.13)	**0.35**(0.14)	**0.34**(0.14)	**0.42**(0.14)	**0.41**(0.13)
r_i	0.09(0.09)	—	—		—
$clust$	—	**0.66**(0.35)	**0.66**(0.35)		—
d_i	—	—	—	1.93(1.72)	**1.53**(0.82)

b) for the Small-Sample

	probability	clustering		degree-out	
	(1)	(2a)	(2b)	(3a)	(3b)
c	**0.70**(0.11)	-0.01(0.15)	—	-0.04(0.17)	—
dum	**0.43**(0.13)	0.40(0.14)	**0.40**(0.12)	0.42(0.14)	**0.40**(0.13)
r_i	0.06(0.08)	—	—		—
$clust$	—	0.32(0.27)	**0.30**(0.15)		—
d_i	—	—	—	2.33(1.97)	**1.93**(1.02)

(*)Standard errors between brackets; significant estimated ($\alpha = 5\%$) in bold.

Columns 2a and 2b study *clustering*: The model without constant shows that clustering is a positive and statistically significant determinant of giving. The later means that the larger clustering the higher donation. Also, its interesting to note that this result is identical to that provided by MRQ with a related measure of clustering. Column 3a and 3b shows that *degree-out* is also a significant and positive determinant of donation.

Result 2: *Both clustering and degree-out increase generosity.*

However, note that effect of degree-out is stronger than the clustering one. More altruistic individuals are those who have a larger number of friends. Hence, this result indicates that the social integration perceived by an individual has a positive effect on giving, i.e., more integrated people are more generous. Summarizing:

Result 2b (conclusion): *Socialization increases individual willingness to give.*

Finally, we study if previous estimations prevail using the *small*–network. Recall that this sample only considers strong social relations. Fortunately, results survive but the effect in giving is not stronger.

Conclusions

This paper explores the relationship between the social networks measures and individuals' donations in DG. We study the data obtained in two different experiments made by the same population: the network elicited by BCJP mechanism and the results of the Dictator Game obtained by BG. We analyze, using a tobit

regression, the effect of three possible explaining variables on donations: *i*) the probability of giving to a friend, *ii*) the number of friends named by a subject and *iii*) the clustering.

Results show that, when an individual faces a friend with a given probability, this has not effect on donations. One possible explanation is that uncertainty makes individuals not to be so generous as if they face a friend for sure (as in BDE setting).

Results also show that both the clustering and the social integration perceived by subjects increase donations.

Finally, this paper analyzes results for two kind of networks, one of them with only friends and one with friends and acquaintances. Results found are very similar for both samples.

References

[1] Brañas-Garza, P., Cobo-Reyes, R. Jiménez, N. and Ponti, G. (2005) A coordination game to elicit social networks: 3 classroom experiments. *Mimeo*, ThE Papers 05/19.

[2] Bohnet, I., and Bruno, S. F. (1999). Social Distance and Other-Regarding Behavior in Dictator Games: Comment. *American Economic Journal* **89**(1): 335-339.

[3] Brañas-Garza, P., Durán, M. and Espinosa, M. P. (2005) Do experimental subjects favor their friends?, *Mimeo*, ThE Papers 05/14.

[4] Brañas-Garza, P and Espinosa, M. P. (2006) Being generous within social networks, *Mimeo*, ThE Papers 06/05.

[5] Brañas-Garza, P. (2006) Motivating helping behavior in dictator games with framing, *Mimeo*, ThE Papers 06/01.

[6] Brañas-Garza, P. (forthcoming) Poverty in Dictator Games: Awakening Solidarity, *Journal of Economic Behavior & Organization.*

[7] Charness, G. and Rabin, M. (2002) Understanding social preferences with simple tests. *Quarterly Journal of Economics* **117**: 817-869.

[8] Charness, G. and Gneezy, U. (forthcoming). What's in a Name? Anonymity and Social Distance in Dictator and Ultimatum Games. *Journal of Economic Behavior & Organization.*

[9] Eckel, C. and Grossman, P. J. (1996). Altruism in Anonymous Dictator Games. *Games and Economic Behavior* **16**(2): 181-191.

[10] Frohlich N., Oppenheimer J. and Moore J. (2001) Some doubts about measuring self-interest using dictator games: the cost of anonymity. *Journal of Economic Behavior & Organization* **46**: 271-250.

[11] Hoffman, E., McCabe, K. and Smith, V. (1996) Social Distance and Other-regarding Behaviour in Dictator Games. *American Economic Review* **86**, 653-690.

[12] Mobius, M., Rosenblat, T. and Quoc-Anh, D. (2005) Social capital in social networks. *Mimeo.*

[13] Vega-Redondo, F. (2004) "Lecture notes in Networks" *Mimeo.*

Conclusiones y Discusión

La investigación llevada a cabo a lo largo de esta tesis utiliza tres disciplinas fundamentales en la economía, como son la teoría de juegos, la economía experimental y la econometría. Las tres disciplinas citadas aparecen en los capítulos expuestos de la siguiente manera: las técnicas econométricas aparecen a lo largo de los tres capítulos, aunque, de ellos, el capitulo 1 es el que utiliza de manera exclusiva la econometría desarrollando un modelo más completo de series de tiempo. El segundo capítulo es un experimento de campo llevado a cabo con una población muy peculiar y poco explorada desde el punto de vista económico: los gitanos españoles. El tercero estudia un juego de coordinación, lleva a cabo un experimento y realiza un análisis econométrico de los datos.

El primer capitulo desarrolla una modificación de los modelos de Hamilton y de Hamilton y Susmel con el objetivo de medir las reacciones frente a shocks en el precio del petróleo tanto de la producción industrial como de la bolsa. Se desarrolla un modelo basado en cadenas de Markov que utiliza el estado en el que se encuentra la economía (expansión o recesión) como variable explicativa que afecta tanto a la producción industrial como a la bolsa. Este capítulo también analiza como afecta una subida en el precio del petróleo a la probabilidad de que la economía se encuentre en un estado de expansión o de recesión.

Los resultados muestran que incrementos en el precio del petróleo van a producir un efecto negativo en la bolsa y en la producción industrial. En el periodo inmediatamente posterior al shock, la bolsa experimenta una reacción a incrementos en el precio del petróleo tres veces mayor que la producción

industrial. Cuatro periodos después, el efecto negativo del shock en el precio del petróleo sobre la producción industrial será dos veces mayor que el efecto sobre la bolsa. Lo anterior demuestra que la bolsa reacciona más rápidamente a cambios en el entorno, pero que a largo plazo, la producción industrial se va a ver afectada de una manera más intensa por shocks en el precio del petróleo.

Otro de los resultados obtenidos muestra que incrementos en el precio del petróleo tendrán un efecto negativo en la probabilidad de que la economía permanezca en un estado de expansión y un efecto positivo en la probabilidad de permanecer en un estado de recesión.

La gráfica que muestra la probabilidad de estar en recesión y las recesiones oficiales del NBER, pone de manifiesto la buena capacidad predictiva del modelo desarrollado, ya que las probabilidades de recesión coinciden de una manera bastante exacta con las recesiones datadas por el NBER.

El capítulo segundo analiza comportamientos de justicia y solidaridad en una población poco estudiada desde el punto de vista económico: gitanos españoles de Madrid. Se plantea un Ultimatum Game con Método Estratégico que se lleva a cabo sobre una población de 38 sujetos. Los sujetos juegan dos tipos de roles, el de oferentes y el de receptores y además se lleva a cabo una encuesta (incluida en el CORE package) para obtener más información acerca de los sujetos.

Los resultados muestran que la división propuesta por los individuos que juegan el rol de oferentes es de 5 Euros para ellos mismos y 5 Euros para el receptor. A pesar del resultado anterior, cuando son los oferentes los que juegan el papel de receptores (de manera hipotética) aceptan cualquier cantidad

ofrecida movidos por un sentimiento de solidaridad con sus compañeros y de deseo de maximización del bienestar social. El análisis econométrico muestra que las variables relacionadas con la educación, religión e integración social no influyen en la cantidad mínima que aceptan los individuos. El número de personas que viven en una casa y el número de invitados a comer tiene un efecto negativo en la cantidad mínima de dinero aceptada, mientras que variables como la pertenencia a un club o la asistencia a la iglesia tienen un efecto positivo en la oferta mínima aceptada.

El apéndice a este capítulo expone otro trabajo derivado del mismo experimento, un experimento hipotético sobre aversión a la desigualdad donde se analizan cuales son las variables que afectan a esta aversión a la desigualdad mediante un modelo logit. El 50% de los sujetos son aversos a la desigualdad. Los resultados más relevantes muestran que las responsabilidades familiares y la religión incrementan la aversión a la desigualdad mientras que la educación hace a los individuos menos aversos a la desigualdad.

El tercer capítulo desarrolla un mecanismo para elicitar redes sociales ya existentes, es decir, un mecanismo para estudiar si en un determinado contexto o situación existen una serie de conexiones o links entre los individuos. Nuestra aproximación nos permite extraerlos y conocerlos y consiste, básicamente, en un juego de coordinación. Los jugadores tienen que coordinarse nombrándose entre ellos (coincidiendo en la valoración que ambos conceden a su amistad) para obtener el pago. Con este juego se pretende obtener información sobre las relaciones establecidas entre individuos en un entorno concreto y utilizarla

a la hora de analizar diferentes comportamientos de los jugadores cuando se enfrentan a diferentes situaciones.

Esto último es la principal aportación de nuestro mecanismo. Hasta ahora, cuando estudiábamos el comportamiento de los individuos, obviábamos (porque desconocíamos) la situación personal del sujeto dentro de su entorno social (si tiene muchos contactos, si es muy importante en su entorno o si su red social es muy amplia); con este mecanismo podemos controlar todos los factores citados, lo que nos permite tener mucha más información acerca de los sujetos experimentales.

Los resultados muestran que el 75% de los links lanzados son correspondidos (es decir, ambos individuos se nombran mutuamente). De esos, el 80% coinciden también en la puntuación (los dos jugadores valoran exactamente igual la relación existente entre ellos), lo que parece indicar que el mecanismo propuesto funciona de una manera razonablemente satisfactoria.

Finalmente, el apéndice de este capítulo muestra una aplicación de los resultados obtenidos en el mecanismo anterior. Se desarrolla un análisis de la relación que hay entre las donaciones altruistas en un juego del Dictador y la integración social de los individuos. Los resultados obtenidos muestran que (i) la probabilidad de jugar con un amigo no afecta a la cantidad donada por el primero y (ii) el clustering y el número de links lanzados por un individuo tienen un efecto positivo en la donación.

Investigación en curso

La primera idea es analizar como las redes sociales afectan a los problemas de coordinación. Estudiaremos si los sujetos que tienen alguna relación entre ellos van a coordinar, en un entorno de batalla de los sexos, de manera diferente que los sujetos que no establecen ningún tipo de relación.

Se plantea un problema de coordinación que enfrenta un equilibrio eficiente a otro no eficiente pero que tiene otras características como por ejemplo la igualdad en los pagos. Por lo tanto, analizaremos si van a existir diferencias significativas entre parejas que tienen relación entre ellos y parejas que no la tienen, tanto desde el punto de vista de la velocidad de coordinación como de la frecuencia y también de la eficiencia del equilibrio en el que coordinan.

La segunda idea ya se aleja del contexto de las redes. En este caso se trata del estudio del juego del Trust Game. Lo que pretendemos analizar es si la presencia de un juez externo va a contribuir a aumentar el nivel de confianza del jugador 1, es decir, si el jugador 1 va a mandar más dinero cuando hay un juez que puede penalizar (con un coste para él mismo) un comportamiento del jugador 2 que él considere incorrecto.

La última idea está relacionada con la segunda. Hay varios artículos (por ejemplo Cox (2004)[63]) que tratan de diferenciar las motivaciones que tiene el jugador 1 a la hora de mandar dinero en el Trust Game. Es decir, tratan de analizar qué parte del dinero se manda por altruismo y que parte se manda para

[63] Cox, J. (2004) How to identify trust and reciprocity. *Games and Economic Behavior* **46**: 260-281.

recibir más dinero.

El artículo de Cox compara dos juegos que en esencia son diferentes entre sí (concretamente un Trust Game y un Dictator Game), con lo que los resultados obtenidos quizás no sean lo más limpios posibles. La idea es modificar el Trust Game (pero manteniendo las principales características de este juego: incertidumbre en el dinero devuelto al jugador 1 y no restricción en la cantidad que el jugador 2 puede devolver al jugador 1) para poder obtener las motivaciones del jugador 1 de una manera más clara, es decir, comparar varios tratamientos con distintas variaciones en el Trust Game para así analizar las distintas motivaciones que tienen los sujetos al jugar este juego.