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ECONOMIC INSIGHTS INTO LOTTERY MARKETS

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A mi familia.

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Abstract

Lottery markets are undergoing a major transformation due to increasing competition and the emergence of new forms of online gambling. Because of this, operators, mostly publicly - owned or licensed conditionally, try to maintain their profitability, market position and social consideration by creating new products which offer bigger and appealing jackpots. Likewise, lottery prizes, due in part to their large size and life-changing consideration, may affect the behavior of individuals, families and even society as a whole. In this context, this doctoral thesis tries to add new empirical evidence about the current situation in lottery markets and to study their effects on society.

In the first chapter of this thesis, aggregate lottery demand functions are estimated at a world region level, and it is particularly analyzed how the aggregate lottery demand is affected by the allocation of funds to different "good causes". Overall, a clear heterogeneity is observed in the incidence of lottery expenses. In general, the lottery is found to be a normal good, even though the results suggest the existence of significant variations in income elasticities across world regions. With regards to the allocation of funds, the results show a negative relationship between lottery sales and financial contributions to society ("good causes"). However, relevant differences exist depending on the adopted earmarking strategy, and so a positive relationship is observed between sales revenue and the allocation of funds for educational or social purposes.

The second chapter analyzes the demand for multi-country (multi-state) lottery games. Focusing on the European lottery EuroMillions as a case study. The results from a jackpot model approach show that there is a very heterogeneous demand across countries, although the jackpot size positively affects the demand in all cases. According to the structure of the game, responsiveness to the jackpot size may also affect the probability for a particular country of hosting a jackpot winner, generating implicit transfers of funds from countries with a less sensitive demand to increases in the jackpot size to those with a highly sensitive one.

Finally, the third chapter uses the first prize of the extraordinary Spanish Christmas draw of the National Lottery as a natural experiment to analyze how households structure decisions are affected by positive random wealth shocks. The evidence is consistent with families getting divorced and having children when the area in which they live experiences an unexpected increase in wealth, but no effect on wedding plans is found.

Resumen

Los mercados de lotería están inmersos en una gran transformación debido a la creciente competencia y a la aparición de nuevas formas de juego online. Debido a esto, los operadores, en su mayoría de propiedad o participación pública, intentan mantener su rentabilidad, posición en el mercado y consideración social mediante la creación de nuevos productos que ofrecen botes más grandes y atractivos. Asimismo, los premios de lotería, debido en parte a su gran tamaño, pueden afectar al comportamiento de los individuos, las familias e incluso la sociedad en su conjunto. En este contexto, esta tesis doctoral intenta añadir nueva evidencia empírica sobre esta nueva situación en los mercados de lotería y también estudiar los efectos de los premios en la sociedad.

En el primer capítulo de esta tesis se estiman funciones de demanda agregada de lotería a nivel de región mundial y se analiza en particular cómo la demanda agregada de lotería se ve afectada por la asignación de fondos a diferentes "buenas causas". En general, se encuentra que la lotería es un bien normal, aunque los resultados sugieren la existencia de diferencias significativas en las elasticidades-renta a nivel geográfico. Asimismo, se observa una clara heterogeneidad en la incidencia de los gastos de lotería. En cuanto a la asignación de fondos, los resultados muestran una relación negativa entre las ventas de lotería y las contribuciones económicas a la sociedad ("buenas causas"). Sin embargo, existen diferencias relevantes según la estrategia de asignación adoptada, por lo que se observa una relación positiva entre los ingresos por ventas y la asignación de fondos para fines educativos o sociales.

El segundo capítulo analiza la demanda de juegos de lotería multinacionales (multiestatales). Poniendo el foco en la lotería europea EuroMillones como caso de estudio. Los resultados de un modelo basado en el bote acumulado muestran una gran heterogeneidad de la demanda entre países, aunque el tamaño del bote acumulado afecta positivamente la demanda en todos los casos. De acuerdo con la estructura del juego, la capacidad de respuesta al bote acumulado también puede afectar a la probabilidad de que en un país en particular resida el ganador del primer premio, generando transferencias implícitas de fondos desde países con una demanda menos sensible a aumentos en la cuantía del primer premio.

Por último, el tercer capítulo usa el primer premio del sorteo extraordinario de Navidad de la Lotería Nacional como experimento natural con el fin de analizar cómo las decisiones estructurales de los hogares se ven afectadas por shocks aleatorios de riqueza. Los resultados indican que un shock de este tipo afecta positivamente la decisión de poner fin a una relación matrimonial, mientras que no afecta a la decisión de comenzarlas; por otra parte, este tipo de shock también afecta positivamente la decisión de tener hijos.

Contents

INTRODUCTION

Lotteries are, without a doubt, the most popular gambling product in the world. Historically, lotteries were introduced into society as financing instruments without the need to resort to taxes. Already in the fifteenth century, what is now called the Netherlands used lotteries as a source of financing to strengthen the walls of their cities or help the most disadvantaged inhabitants. In the same century, the Government of the city of Milan used the lottery as a way of financing the war with the Republic of Venice. Later, other countries such as France or England imitated this practice, until in the modern age there was an outbreak of lotteries managed directly by the State.

A characteristic shared by almost all lottery markets is the State's obligation for the different operators, public and private, to make monetary contributions to society. That is why, also today, lotteries can be considered a fundamental part of public financing.

In addition to the public interest in lotteries as an alternative method of collection, the economic analysis of lottery markets is an interesting field since a specific paradox arises: playing the lottery seems to be economically irrational (Friedman and Savage, 1948). Given this fact, economic science has made an exceptional contribution to understanding the determinants of lottery consumption. In 1989 and 1990 Clotfelter and Cook (Clotfelter and Cook, 1989, 1990) showed that the relationship between the level of income and the level of spending in lottery products was weak, while they found a strong relationship between the level of prizes offered and this lottery claim. These relationships were later evidenced in seminal contributions to gambling economics, such as Scott and Gulley (1995); Farrell and Walker (1999); Forrest et al. (2000) and Walker and Young (2001). As will be seen later in this thesis, there is a certain academic consensus regarding the regressivity of lotteries as a financing instrument from the point of view of Public Economics.

Whatever the reasons for its consumption and the origin in terms of class and social stratum of its consumers, the importance and social relevance of this market is undeniable. In 2017 alone, and according to data from the World Lottery Association (WLA), sales of lottery products around the world amounted to three hundred and three billion dollars, with thirty-two percent of that amount being sold in Europe.

A relevant fact that must be taken into account is that the global lottery industry is immersed in a period of transformation. In the first place, the technological advances of recent decades have made it possible to consume lotteries online. In addition, the number of Internet users in the world has increased exponentially, which has facilitated access to those potential consumers with some type of physical barrier to lottery consumption, which may increase the demand for products.

But technological advances can also play against these types of games. In fact, the main substitute product, online betting, has increased competition in this market, forcing traditional lottery operators to innovate and change their marketing strategies to try to retain current buyers and try to attract new ones. The lottery industry has managed to create games that offer larger prizes, unattainable for its competitors, bringing together participants from different countries, all of them opting for a common prize that far exceeds the prize offered by other types of products. In addition, lottery operators have tried to bring their products closer to society in an attempt to improve their image. Many of them have chosen to expand their contributions to society through policies to support sports, culture, education or social work.

Faced with this change of scenery, both the scientific community and society in general are once again asking questions that, in part, had previously been answered in the literature: Are these products always regressive? Do consumers really appreciate that lottery operators allocate their own funds to social causes? Are prizes distributed equally? And how do individuals and societies react when they receive a big lottery prize?

Facing these new questions, and in order to generate empirical evidence that helps society and its representatives to understand the effect that the lottery and its new formats have on it, the need arises to update the economic literature. The significance of this new evidence goes beyond regulating a market if necessary. As mentioned above, for historical and fundraising reasons, most lottery operators are publicly owned or participated. It is also a question, then, of deciding whether a company owned by the public sector should form part of this type of market. If so, it is also necessary to know precisely what benefits and harms they have in society in general and in its different social components in particular, in order to reduce their negative consequences and expand those that benefit them. In addition, it is necessary to think about the strengths and weaknesses of the state lottery markets in terms of future participation in the gambling market. Understanding the dynamics and macro behavior of these markets in a country context is crucial to face future challenges and discuss the maintenance of lottery payments for society.

The objective of this thesis is precisely that: to contribute to society as a whole, and to the economic literature in particular, with new scientific evidence that responds precisely to new questions such as those listed above and that helps to understand the dynamics and behavior of lottery markets. In order to meet this objective, aggregated lottery consumption data has been collected at the global, continental and national levels, dividing it into three databases that have been used to write the three chapters that make up this thesis and which are structured as follows:

- First chapter: Where the money goes: The role of funding allocation in lottery markets.

  Using panel data information from The World Lottery Association (WLA) Global Lottery Data Compendium this chapter studies two important public aspects of state lotteries. First, it examines specific world region differences in the income elasticity of lottery. Second, this chapter studies how lottery markets around the world respond to different funding allocation strategies, but also how lottery sales respond to the macroeconomic conditions. The results provide evidence that a significant variation in the income elasticities across geographic areas exists. Also, a clear heterogeneity in the incidence of lottery expenditures is observed. The empirical findings also show a negative relationship between lottery sales and financial contributions to society. However, relevant differences exist depending on the funding strategy adopted, and a positive link between sales revenue and allocating funds to education or social purposes is observed.

- Second chapter: The market of EuroMillions: Sales trends, jackpot sensitivity and implicit transfers of funds among countries.

  Multi-country (state) lottery markets have emerged worldwide as an attempt to revert decline in lottery sales. Using data at a country level, this chapter analyzes sales and market share trends in the market for EuroMillions lottery tickets over a period of 1237 draws. The focus is on studying whether distinct sales trends across participant countries exist, whether market shares respond differently to the jackpot size, and on analyzing the implicit transfers of funds among countries as a consequence of the distribution of the jackpot wins. Evidence suggests that while jackpot size positively influences the demand for EuroMillions lottery tickets in all jurisdictions, trends in sales market share have differed across countries affecting the odds of hosting a national winner. As a result, some countries could then benefit from the funds that have been contributed to the prize pool by the rest, raising some implicit transfers of funds issues.
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- Third chapter: Household structure decisions and positive wealth shocks: A natural experiment.

  This last chapter uses the first prize of the Christmas Draw of National Spanish Lottery as a natural experiment to determine the behavior of Spanish families in the face of positive wealth shocks that affect their province of residence. Specifically, it analyzes how a shock of this type affects three structural decisions: marry, separate or divorce, and have a child. To carry out this analysis, a database has been created that collects at the provincial level the distribution of the first prize of the said draw from 2000 to 2018. The methodology used is the difference-in-differences. The results indicate that this type of wealth shock

positively affects both the birth rate and the divorce rate in the winning province, finding no effects on the marriage rate. Due to the demographic situation in Europe, this chapter provides fundamental evidence to understand the effects of possible economic policies on the population.

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INTRODUCCIÓN

Las loterías son, sin lugar a duda, el producto de juego de azar más popular alrededor del mundo. Históricamente las loterías fueron introducidas en la sociedad como instrumentos de financiación sin necesidad de recurrir a impuestos. Ya en el siglo XV los hoy llamados Países Bajos utilizaron las loterías como fuente de financiación para fortalecer las murallas de sus ciudades o ayudar a los más desfavorecidos. En el mismo siglo, el Gobierno de la ciudad de Milán utilizó la lotería como forma de financiación de la guerra con la República de Venecia. Tiempo después, otros países como Francia o Inglaterra imitaron esta práctica, hasta que en la edad moderna se produjo una eclosión de loterías gestionadas directamente por el Estado.

Una característica compartida por casi la totalidad de los mercados de lotería es la obligación por parte del Estado a los diferentes operadores, públicos y privados, de realizar contribuciones dinerarias a la sociedad. Es por ello que, también en la actualidad, las loterías pueden ser consideradas parte fundamental de la financiación pública.

Además del interés público en las loterías como método alternativo de recaudación, el análisis económico de los mercados de lotería es un campo interesante ya que se presenta una paradoja específica: jugar a la lotería parece ser económicamente irracional (Friedman and Savage, 1948). Ante este hecho, la ciencia económica ha contribuido de manera excepcional a entender los determinantes del consumo de loterías. En 1989 y 1990 Clotfelter y Cook (Clotfelter and Cook, 1989, 1990) demostraron que la relación entre el nivel de ingresos y el nivel de gasto en los productos de lotería era débil, mientras que encontraron una relación fuerte entre el nivel de premios ofrecido y esta demanda de lotería. Estas relaciones fueron posteriormente evidenciadas en contribuciones seminales de la economía del juego, como pueden ser Scott y Gulley (1995); Farrell y Walker (1999); Forrest et al. (2000) y Walker y Young (2001). Como se podrá observar más adelante en esta tesis, existe cierto consenso académico en torno a la regresividad de las loterías como instrumento de financiación desde el punto de vista de la Economía Pública.

Sean cuales sean los motivos de su consumo y la procedencia en términos de clase y estrato social de sus consumidores, la importancia y relevancia social de este mercado es innegable. Solo en 2017, y según los datos de la Asociación Mundial de Loterías (WLA, por sus siglas en inglés), las ventas de productos de lotería alrededor del mundo ascendieron a trescientos tres mil millones de dólares, vendiéndose en Europa el treinta y dos por ciento de dicho importe.

Un hecho relevante que ha de ser tenido en cuenta es que la industria lotera mundial está sumergida en un periodo de transformación. En primer lugar, los avances tecnológicos de las últimas décadas han hecho posible el consumo de loterías de manera online. Además, el número de usuarios de internet en el mundo ha aumentado exponencialmente, lo que

ha facilitado el acceso a aquellos potenciales consumidores con algún tipo de barrera física al consumo, pudiendo aumentar así la demanda de los productos.

Pero los avances tecnológicos también pueden jugar en contra de este tipo de juegos. De hecho, los principales productos sustitutivos, las apuestas online, han aumentado la competencia en este mercado, obligando a los operadores tradicionales de lotería a realizar innovaciones y cambios en sus estrategias de marketing para intentar retener a los actuales compradores e intentar captar otros nuevos. La industria lotera ha conseguido crear juegos que ofrecen premios de una gran cuantía, inalcanzables para sus competidores, aglutinando participantes de diferentes países, optando todos ellos a un premio común que supera con creces el premio ofrecido por otro tipo de productos. Además, los operadores de lotería han intentado acercar sus productos a la sociedad en un intento de mejorar su imagen. Muchos de ellos han optado por ampliar sus aportaciones a la sociedad mediante políticas de apoyo al deporte, cultura, educación u obra social.

Ante este cambio de escenario, tanto la comunidad científica como la sociedad en general se vuelven a preguntar cuestiones que, en parte, habían sido contestadas previamente en la literatura: ¿Son estos productos siempre regresivos? ¿realmente valoran los consumidores que los operadores de lotería destinen fondos propios a las causas sociales? ¿se distribuyen de manera equitativa los premios? ¿y cómo reaccionan individuos y sociedades cuando reciben un gran premio de lotería? ¿y las familias?

Frente a estas nuevas preguntas, y con el fin de generar evidencia empírica que ayude a la sociedad y a sus representantes a entender el efecto que la lotería y sus nuevos formatos tienen en ella, nace la necesidad de actualizar la literatura económica. La trascendencia de esta nueva evidencia va más allá de regular un mercado si fuera necesario. Como se mencionaba anteriormente, tanto por motivos históricos como de recaudación, gran parte de los operadores de loterías son de propiedad o de participación pública. Se trata también, entonces, de decidir si una empresa participada por el sector público ha de formar parte de este tipo de mercado. En caso afirmativo, también resultaría necesario saber con precisión qué beneficios y perjuicios tienen en la sociedad en general y en sus diferentes componentes sociales en particular, con el fin de reducir sus consecuencias negativas y ampliar aquellas que la beneficia. Además, es necesario pensar en las fortalezas y debilidades de los mercados de loterías estatales en términos de participación futura en el mercado de juegos de azar. Comprender la dinámica y el comportamiento macro de estos mercados en el contexto de un país es crucial para enfrentar los desafíos futuros y discutir el mantenimiento de los pagos de lotería para la sociedad.

El objetivo de la presente tesis es precisamente ese: contribuir a la sociedad en su conjunto y a la literatura económica en particular con nueva evidencia científica que responda de manera precisa a nuevas preguntas como las enumeradas anteriormente y que ayude a entender la dinámica y el comportamiento de los mercados de lotería. Con el fin de cumplir con este objetivo, se han recopilado datos agregados de consumo de loterías a nivel mundial, continental y nacional, dividiéndose en tres bases de datos que han sido

aprovechadas para escribir los tres capítulos que conforman esta tesis y que se estructura de la siguiente manera:

- Capítulo primero: A dónde va el dinero: El papel de la asignación de fondos en los mercados de lotería.

  Utilizando información con formato de datos de panel obtenida directamente de los Compendios de la Asociación Mundial de Loterías (WLA), este capítulo estudia dos aspectos públicos importantes de las loterías estatales. Primero, examina las diferencias específicas entre regiones mundiales en la elasticidad renta de la lotería. En segundo lugar, este capítulo estudia cómo los mercados de lotería de todo el mundo responden a diferentes estrategias de asignación de fondos, pero también cómo las ventas de lotería responden a la situación macroeconómica. Los resultados proporcionan evidencia sobre la existencia de variación significativa en las elasticidades renta entre áreas geográficas. Asimismo, se observa una clara heterogeneidad en la incidencia de los gastos de lotería. Los hallazgos empíricos también muestran una relación negativa entre las ventas de lotería y las contribuciones financieras a la sociedad. Sin embargo, existen diferencias relevantes en función de la estrategia de financiación adoptada, y se observa una relación positiva entre los ingresos por ventas y la asignación de fondos a fines educativos o sociales.

- Capítulo segundo: El mercado de EuroMillones: Tendencias de las ventas, sensibilidad al bote acumulado y transferencias de fondos implícitas entre países.

  Los mercados de lotería multi estado han surgido en todo el mundo como un intento de revertir la caída en las ventas de lotería. Utilizando datos a nivel de país, este capítulo analiza las ventas y las tendencias de participación en el mercado del producto de lotería EuroMillones durante un período de 1237 sorteos. La atención se centra en estudiar si existen distintas tendencias de ventas entre los países participantes, si las cuotas de mercado responden de manera diferente al tamaño del primer premio y en analizar las transferencias de fondos implícitas entre países como consecuencia de la distribución de los primeros premios. La evidencia sugiere que, si bien el tamaño del bote acumulado influye positivamente en la demanda de boletos de EuroMillones en todas las jurisdicciones, las tendencias en la participación del mercado de ventas han sido diferentes entre los países, lo que afecta las probabilidades de albergar un ganador nacional. Como resultado, algunos países podrían beneficiarse de los fondos que el resto ha aportado al fondo de premios compartido.

- Capítulo tercero: Decisiones estructurales del hogar y shocks positivos de riqueza: Un experimento natural.

  Este último capítulo usa el primer premio del Sorteo Extraordinario de Navidad de la Lotería Nacional en España como experimento natural con el fin de determinar el comportamiento de las familias españolas ante shocks positivos de riqueza que afectan a su provincia de residencia. En concreto, se analiza cómo afecta un shock de este tipo a tres decisiones estructurales: casarse, separarse o divorciarse y tener un hijo. Para llevar a cabo este análisis, se ha creado una base de datos que recoge a nivel provincial la distribución del primer premio de dicho sorteo durante los años 2000 a 2018. La metodología utilizada es la de diferencia en diferencias. Los resultados indican que este tipo de shock de riqueza afecta positivamente tanto a la tasa de natalidad como a la de divorcio en la provincia agraciada, no encontrando efectos en la tasa de nupcialidad.

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CHAPTER 1. WHERE THE MONEY GOES: THE ROLE OF FUNDING ALLOCATION IN LOTTERY MARKETS

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Introduction

As previously mentioned in this thesis, lottery is probably the most popular state licensed and controlled gambling product. The worldwide market for lottery includes a huge number of countries and jurisdictions where operators provide this gambling product to the public in different regulated environments.

A fundamental characteristic of state lotteries – and the key difference to the commercial gambling industry – is that gambling products (lotteries, sports betting, etc.) are operated for the public benefit. Accordingly, the state lotteries' proceeds are used for the benefit of society as a whole rather than being a source of private profit. Thus, governments argue that authorized lotteries promote social welfare and are morally appropriate (Miller and Pierce, 1997).

Therefore, the introduction of lotteries in the gambling market is in line with the public's interest in them as an alternative method for the government to raise new revenue without raising taxes. In this aspect, Alm et al. (1993) highlighted the effects of fiscal pressure or political decisions on the creation of public lottery operators, and Jackson et al. (1994) also indicated that political decisions play a fundamental role in these organizations. More recent contributions like Grote and Matheson (2011) and Pérez and Humphreys (2013) indicate also economic development, election cycles or fiscal health as factors that induce Governments to create public lotteries.

Based on this public interest argument, these markets are strongly regulated and even sometimes operated under a public monopoly structure. Their success in terms of sales, and therefore the revenue they generate, is backed by the supply of long-odds gambling products which offer appealing life-changing prizes.

For the use of lotteries as a public finance tool[1], operators must be authorized to provide gaming services by the corresponding public authority, with the objective to meet the demand for lottery in a responsible and regulated manner. In addition, as an act of social responsibility, they are required to make mandatory financial contributions to society (funding specific good causes or allocating money directly to the public treasury). On average, a state licensed lottery gives back to society as mandatory payments – as opposed to and not including sponsorships but including taxes and other charges – 29% of revenue sales and some even return almost 70%.[2]

Governments have, consequently, authorized lotteries primarily as a means of generating non-tax revenues which are often allocated to particular public purposes, usually including education, sports, social causes, etc., or directly to the treasury with no assigned allotment. Thus, a common strategy to support state lotteries has been to allocate a share of lottery profits to a particular public service program. As a result, over 100 countries and 200 jurisdictions worldwide have recourse to lotteries for raising general revenues to help public finance or specific purposes (Ariyabuddhiphongs, 2011; Pérez and Humphreys, 2013).

Moreover, lotteries are challenging markets to understand and model since they are more complex than it appears at first glance. Beyond the public interest in lotteries as an alternative method for the government to raise revenue - the parameters of lottery games are generally set to maximize revenue to the state (Gulley, 2018) -, the economics of lottery markets is an interesting field to study since it contains a specific paradox: playing the lottery seems to be economically irrational. In this aspect, critics of government sponsored lotteries frequently claim that low-income individuals purchase a disproportionate number of lottery tickets, adding additional emphasis to research on the relationship between income and lottery spending (Pérez and Humphreys, 2011).

Precisely for this reason it is interesting to study the income elasticity of lottery: income is one of the key determinants of lottery expenditure and understanding the determinants of lottery expenditure is important because of the extreme popularity of lottery and the high level of purchase involvement in countries around the world (normally a positive relationship between consumers' income and the demand for lottery is observed). In addition, the income elasticity of lottery is an important parameter for policy analysis in order to identify patterns in lottery expenditure across the income distribution – e.g.

[1] The use of lotteries as a public finance tool remains controversial. Those opposed to the use of lotteries have based their objections on issues such as the regressivity of lottery tax as well as moral considerations (Skidmore and Tosun, 2008). On the other hand, lottery supporters use the good causes and funding allocation argument.

[2] The Swedish operator, *AB Svenska Spel*, allocated on average 60% of sales revenue to public purposes during the sample period. This figure increased to 69.32% in 2014. In any case, it should be noted that this includes not only the funding allocating to either good causes or the public treasury, but also taxes and other mandatory payments.

income elasticities less than one indicate a less than proportional percentage change in sales given a 1-percent change in income suggesting lottery as a regressive implicit tax.

Although much research has been done on lottery markets and empirical estimation of aggregate demand functions is common in the lottery literature (e.g., Mikesell, 1989; Cook and Clotfelter, 1993; Price and Novak, 2000; Garrett and Coughlin, 2009; Ghent and Grant, 2010; among other studies commonly referenced in the literature), there is a lack of studies of lotteries from an international perspective. Apart from Garrett (2001) and Matheson and Grote (2009) that provide cross-country studies of lottery markets, most of the studies published to date on lotteries have been made at either a national or regional level.

This chapter adds to the scarce number of comparative studies on lottery demand among different jurisdictions. Compared to previous literature, the use of panel data allows to examine specific world region differences highlighting the similarities or differences in the stability of lottery revenues worldwide. Its main contributions are to provide estimates of income elasticities taking into account different gambling regulatory environments across world regions. As previously discussed, this is a relevant policy issue and can be considered as the most common statistic in the debate on the efficacy of lotteries as an appropriate means of government finance, as it provides evidence on the distributional burden (by income) of lottery expenditures (Garrett, 2016). On the other hand, this chapter also provide evidence on the negative relationship between lottery sales and financial contributions to society. However, relevant differences exist depending on the funding strategy adopted, and a positive link between sales revenue and allocating funds to education or social purposes is observed.

A brief review of previous literature

While Garrett (2001a) and Matheson and Grote (2009) provide cross-country studies of lotteries, very little work has been done comparing lottery demand, structures, and funding allocation models among different jurisdictions worldwide. Most of the studies published to date have been made at either a national or state (regional) level. And this is also the case for the branch of studies devoted to analyzing the allocation strategies for lottery revenues, including Mikesell and Zorn (1986), Borg and Mason (1990), Garrett (2001b), Rubenstein et al. (2002), Landry and Price (2007), Pantuosco et al. (2007), Hedenus (2014), and Jones (2015), among others.

Even though some empirical evidence supporting the beneficial application of lotteries could be found, as in Morgan and Sefton (2000) and Lange et al. (2007), there is a limited empirical literature analyzing the relationship between funding allocation and lottery sales at the country level.

In any case, although there seems to be a consensus that the allocation of lottery funds to society does not exclude any of the fundamental theories about why people buy lottery

tickets (expected utility maximization (Friedman and Savage, 1948), prospect theory (Kahneman and Tversky,1979), or Conlisk (1993)'s utility of gambling), it could clearly be complementary to them. Therefore, it would be possible for people to support the introduction of a lottery and even to acquire some additional utility in buying lottery tickets if they knew that a portion of the price would be allocated to a specific public purpose, even if the ticket purchased does not win any prize. The utility of the game will increase for an individual who buys lottery tickets considering that part of the funds will go to charitable causes and/or revert back in the form of payments to society, generating an increase in the demand for lottery tickets.

Some previous papers in the literature seem to support this thesis. Stivender et al. (2016) deduce that if individuals value the contributions made by the lottery, they are more likely to buy lottery tickets as an indirect contribution to public finances. Thus, under this assumption, participation in the lottery market could be understood as a function of the (perceived) use of funds. Under this framework, funding allocation would serve as a strategy, not only to differentiate the monetary prize as a special type of money (Hedenus, 2014), but also to influence the aggregate demand for lottery money. If that is the case, there should be statistically significant differences among different funding allocation systems and countries.

From the other market perspective, that of supply, operators, being cognizant of the preferences of lottery buyers, will allocate more (or less) funds to society in an attempt to maximize their profits, trying to choose the best strategy to boost their sales. Funding allocation can therefore be considered a successful marketing strategy that goes beyond an act of solidarity.

Data sample

Information on worldwide lottery markets have been obtained for the years 2013 to 2017 from *The WLA Global Lottery Data Compendium*, an annual review of the lottery industry based on data from the World Lottery Association (WLA) members. It reports detailed information about lottery markets including all types of lottery games sales, funding allocation, regulations, etc. On the other hand, aggregate data on market size and income, in this case measured as population and Gross Domestic Product, has been obtained from *World Bank Open Data*.

The lottery sales data were restricted to national lottery operators that have reported their figures to the WLA during the sample period. Regional/state operators have been excluded because their area of activity is not well specified or because of a lack of macroeconomic information. Similarly, US lottery operators were not included for data availability reasons. In addition, some operators do not declare any allocation of lottery revenue and therefore the final use of these funds is not reflected in the WLA Compendium and thus in the data used here. So, the baseline sample set consists of a

balanced panel of 61 nationwide lottery operators, from 54 different countries, observed over 5 years.

Table 1.1 summarizes relevant figures per global region from the lottery markets (operators and countries) considered. Note that lottery sales revenue and income (GDP) were converted into USD by using the corresponding average annual exchange rate and then deflated by each country consumer price index to transform them in real terms. Consequently, these two variables are measured in 2011 USD. Due to the differences in the number of lottery operators that report their sales to the *World Lottery Association*, Europe is the more representative world region in the sample, with more than the fifty per cent of the countries registered. Some interesting facts can be observed. First, during the sample period (2013-2017), lottery ticket sales account on average for at least 0.44% of each country's GDP, reaching 1% of Asian countries GDP. Second, in terms of per capita lottery sales, different groups of regions can be observed: African countries median expenditure is slightly over 12 USD per capita; in both Latin America and Asia median per capita sales are close to 25 USD; a third group includes Europe, whose population median spending in lottery tickets is more than 90 USD; finally, New Zealand lottery market median per capita sales exceed 140 USD.

Table 1.1. International comparison of lottery markets by world region (2013-2017).

	Africa	Asia	Europe	Latin America	Oceania	Global
# countries	7[a]	9[b]	29[c]	8[d]	1[e]	54
Median GDP (million 2011 USD)	26,418	710,951	229,211	256,937	159,666	231,825
# lottery operators	8	11	33	8	1	61
Median sales (million 2011 USD)	211	2,026	614	396	678	578
Sales/GDP	0.77%	1.01%	0.54%	0.46%	0.44%	0.64%
Median (per capita) sales (2011 USD)	12.71	26.90	92.33	24.55	145.42	54.15

Notes: [a] Burkina Faso, D.R. of the Congo, Ghana, Morocco, Mauritania, Niger and Togo. [b] China, Hong Kong SAR, India, Israel, Japan, Lebanon, Philippines, Thailand and Sri Lanka. [c] Austria, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, France, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, Luxembourg, Malta, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Turkey and United Kingdom. [d] Brazil, Chile, Ecuador, Mexico, Panama, Peru, Trinidad and Tobago and Saint Lucia. [e] New Zealand. [f] Countries with two nationwide lottery operators include: Denmark, Italy, Spain, Sweden, Morocco, China and Japan.

As mentioned, the WLA data provide full information on how each operator allocates lottery revenue (public treasury, good causes…). In particular, the report distinguishes between funds that go directly to the public treasury (sometimes called "cash for treasury"), from where they are distributed to different purposes, and those allocated to specific good causes. In the 2013 to 2017 period, the 61 WLA operators analyzed here raised over 80,000 million 2011 USD in money for good causes.

Good causes are classified into five categories: culture – revenue from lottery funds that support projects in the field of culture and heritage; education – money returned to society in the form of payments for educational purposes; social activities – donating revenue from lottery to charitable causes and other social activities; sport – payments made in support of sport; and "other good causes" – covers compulsory payments to society that are specifically allocated to good causes other than education, culture, social activities and sport, such as the environment, healthcare and other public services or facilities.

Table 1.2 shows the (average) proportion of sales and (average) per capita Euros allocated to each of the two main uses of lottery funds (public treasury and good causes) by operator's country location (world region). In addition, this information is also presented for the five previously mentioned good causes categories.

Table 1.2. Different funding allocation strategies (2013-2017).

Note: It should be noted that not always the same operators that allocate funds to the treasury do it, at the same time, to a specific good cause.

		Africa	Asia	Europe	Latin America	Oceania	Global
# lottery operators allocating lottery revenue directly to the public treasury		3-4	6-7	24-27	4-5	1	39-42
Public treasury	Sales proportion	4.11%	10.01%	13.51%	5.73%	27.80%	10.86%
	per capita USD	1.28	83.41	23.68	17.27	42.07	30.07
# lottery operators declaring specific allocation of lottery funds		3-4	6	25-27	4-5	-	38-42
Good causes (total)	Sales proportion	0.59%	6.10%	9.30%	9.33%	-	7.43%
	per capita USD	0.21	4.10	15.84	6.78	-	11.68
Culture	Sales proportion	0.04%	0.02%	0.68%	0.31%	-	0.64%
	per capita USD	0.01	0.03	2.95	0.53	-	2.09
Education	Sales proportion	0.08%	0.07%	0.06%	0.99%	-	0.29%
	per capita USD	0.06	0.11	0.29	1.17	-	0.39
Social	Sales proportion	0.20%	0.63%	1.96%	0.05%	-	1.84%
	per capita USD	0.07	0.44	9.22	0.80	-	5.14
Sport	Sales proportion	0.05%	3.59%	2.77%	2.42%	-	3.77%
	per capita USD	0.03	3.78	7.93	4.31	-	6.16
Other causes	Sales proportion	0.20%	1.77%	3.68%	5.32%	-	4.62%
	per capita USD	0.13	1.21	9.07	2.95	-	6.29

Through the sample period, lottery operators worldwide allocated (on average) 7.43% of lottery sales revenue to good causes, while this percentage was 10.86% in the case of the revenue share that went directly to the public treasury. So, just over 11 USD per capita in the former case and 30 USD per capita in the latter.

With the exception of New Zealand, lottery operators in the sample opted for both funding allocation strategies (public treasury and good causes). However, differences among funding allocation policies by operator's location can be derived from Table 1.2. In Africa, Asia, Europe, and Oceania, the highest percentage of money from the lottery goes directly to the public treasury, over 40 USD per capita in Oceania, and 83 USD per capita in Asia. This can be explained by the huge number of payments to the treasury made by the Hong Kong operator, *HKJC Lotteries Limited* (more than 400 USD per capita per year). African operators allocate the smallest percentage of lottery proceeds to payments to society. Most operators in Latin America opt to use the lottery funds for some specific good cause, accounting for more than 9% of sales revenue.

In terms of the five good causes categories in this study, just over 4.5% of lottery sales worldwide go to "other causes." This can be explained by lottery operators in Latin America allocating a large proportion of funds to this particular use: for every citizen in the considered countries, 2.95 USD from the lottery are allocated to payments to society, such as the environment, healthcare, and other public services or facilities. Turning to other specific good causes, it can be noted that in the case of Asian and European operators, the money from the lottery basically goes to support sport and social activities, whereas in Latin America operators also opt to finance education with lottery money.

Empirical model

Methodology

This chapter adopts an economic approach to investigate the role funding allocation plays within the state-authorized lottery model in different regions of the world under different regulatory environments. Aggregate data on lottery sales, population (market size), and some macroeconomic variables, including income (GDP) and domestic credit to the private sector (% of GDP)[3], are used to analyze the international distribution of the money raised by lotteries. Specifically, the empirical approach focuses on estimating an aggregate demand function for lotteries but controlling for the alternative ways in which lottery funds are allocated. The available information has a panel data structure which allows observing the previous mentioned variables at the country level for the 2013-2017 period.

Although aggregate data can certainly be used to study changes in market demand due to changes in, say, market size and income, a critique of this analysis would be that using country-level data to make inferences about individual behavior would assume that all consumers within a jurisdiction have identical preferences.

In any case, empirical estimation of aggregate demand functions is quite common in the literature that examines the demand for state-lottery tickets (e.g., Mikesell, 1989; Cook

[3] This data has been obtained from *World Bank Open Data* – https://data.worldbank.org/.

and Clotfelter, 1993; Hansen, 1995; Price and Novak, 1999, 2000; Tosun and Skidmore, 2004; Garrett and Couglin, 2009; Ghent and Grant, 2010) – these studies are only a few examples of the work done in the area of state-lottery demand; see Grote and Matheson (2011) and Perez and Humphreys (2013) for additional studies and further discussion. However, apart from Garret (2001a), there is a lack of studies in the field of international lotteries at a country level and from an international perspective.

Model specification and variables

The baseline panel data model to estimate is described in Equation 1.1,

$$y_{it} = f(x_{jt}, z_{it}, w_j) \tag{1.1}$$

where lottery sales revenue for operator *i* in year *t* (y_{it}), is described as a function of macroeconomic and market variables in year *t* for the country *j* in which operator *i* operates (x_{jt}), a vector of lottery characteristics (percentage of sales allocated to society – either in the form of payments to the treasury or good causes funding – and the existence of competing operators) including a dichotomous indicator that controls for the different funding allocation strategies (z_{it}), and a set of categorical variables that stand for the world region in which country *j* is (w_j). Subscript t accounts for years 2013 to 2014.

Each country's GDP and population are included in the specification to control for the income effects and the size of the market, respectively. Also, each country's domestic credit to the private sector (% of GDP) is considered to control whether observed differences can be explained by financial reasons. This refers to financial resources provided to the private sector (including consumers) by financial corporations, such as through loans and trade credits. The demand for lottery could be correlated with recourse to credit, since the costs of purchasing a car, a house, or a university education are beyond the regular income of consumers unless the money is obtained by credit. The lottery can be then understood as a fickle form of finance to afford such indivisibility expenses (Kwang, 1965). There are changing economic and demographic conditions among countries. Lottery sales revenue and income (GDP) were deflated by each country consumer price index to transform them in real terms. Consequently, these two variables are measured in 2011 USD.

Results

Table 1.3 shows the estimated coefficients by random-effects model[4] for Equation 1.1, where each model specification differs only in the good causes indicator considered, in order to analyze whether there is any significant relationship between lottery sales and the allocation made to any of the specific good causes described earlier in the chapter. So, in the first column, the dichotomous variable that controls for the different funding allocation strategies among the good causes categories considered (*good causes indicator*) takes value 1 if the operator allocates funding to culture and 0 otherwise. Similarly, for columns 2 to 5, the good causes indicator accounts for the other categories (education, social, sport, other). A set of lottery characteristics is also included in the specification counting for the existence of competing operators and the percentage of sales revenue devoted to public accounts (society).

Given the functional form chosen for the demand equation, the estimated coefficient of the economic variables in natural logarithm form could be directly interpreted as short-run elasticities.

Table 1.3. Funding allocation and good causes strategies (2013-2017).

Dependent variable: (*log*) (*per capita*) Lottery sales

	Culture (1)	Education (2)	Social (3)	Sport (4)	Other (5)
Good causes indicator	0.021	0.144***	0.162***	0.038	-0.004
% to society	-0.567**	-0.574**	-0.576**	-0.579**	-0.558**
Competing operators	-0.752*	-0.754*	-0.777*	-0.732*	-0.738*
(per capita) GDP	0.894***	0.940***	0.943***	0.891***	0.881***
Population	-0.192	-0.189	-0.189	-0.195	-0.199
Credit to private sector (% GDP)	0.867***	0.861**	0.866**	0.860**	0.868**
Constant	9.777***	9.904***	9.909***	9.822***	9.840***
Year dummies	YES	YES	YES	YES	YES
World region dummies	YES	YES	YES	YES	YES
R^2 overall	0.490	0.501	0.497	0.492	0.487
# observations	305	305	305	305	305
# lottery operators	61	61	61	61	61
# time periods	5	5	5	5	5

*Note: * Significant at 10%; ** significant at 5%; ***significant at 1%. (per capita) GDP and population are in natural logarithm form.*

[4] In order to determine whether the panel data model is fixed effects or random effects, a Hausman (1978) specification test is performed suggesting the use of random effects is appropriate.

The results in Table 1.3 indicate that allocating funds to education or social activities are correlated with greater lottery sales. All other possible uses of the money from the lottery do not appear to have a statistically significant effect on sales.

In particular, per capita lottery expenditures are approximately 15% higher for those operators that allocate lottery proceeds to education. And it rises to over 17% in the case of donating revenue from lottery to charitable causes and other social activities. However, a negative correlation can be observed between the percentage of sales allocated to public accounts (payments to the treasury and good causes funding) and the lottery sales achieved. As expected, the existence of competing operators in the same jurisdiction negatively impacts each operator's sales revenue, but this effect is significantly weak.

Combined, these results suggest that in terms of lottery sales it is (positively) important what the funds are allocated to (specific purpose) and (negatively) how much of sales are assigned (in general) to make payments to society. The latter can be easily explained by the fact that the amount of money allocated to any purpose is removed from the amount of money that goes into the prize pool negatively affecting lottery demand. In any case, following Landry and Price (2007), if the sole motivation for lottery play was the opportunity of winning a prize, per capita expenditures should be independent of the designation of proceeds allocated to a particular public service program. This could even be used as an argument in favor of the lottery.

Although it is aimed to assess the effects of funding allocation and good causes strategies in worldwide lottery markets, I also comment on the results of the control variables included in all model specifications in Table 1.3. Since the model we are estimating corresponds to demand equation, we included, as previously alluded to, a proxy for income at the country level (GDP) and a variable capturing the size of the market (population), both having geographical and time variation.

The results for all the considered specifications indicate a positive and significant effect for the income variable, identifying the lottery as a normal good. In addition, the estimated income elasticities below the value of one show, as in Clotfelter and Cook (1990), that sales revenues increase less than proportionately with income (GDP), which makes lottery, as an implicit tax, regressive. With respect to the population variable, a non-significant negative effect of the market size is obtained.[5]

Finally, a positive correlation is found between lottery sales and credit to the private sector as a percentage of GDP. In those jurisdictions with higher recourse to credit, it appears that the demand for lottery tickets is greater, confirming that lottery is perceived as an alternative financial resource.

[5] It should be pointed out that part of the geographical variability of the population is captured by the world region dummies.

Robustness test

Given the correlational nature of the data and likelihood of endogeneity**,** some correlation and collinearity diagnostic measures were computed. First, no correlation coefficient between a particular good cause indicator and the other control variables was found to be statistically significant at the 5% level after Bonferroni adjustment. Second, an analysis of the variance inflation factors (VIF) showed there is no evidence of multicollinearity. Finally, following Davidson and MacKinnon (1993) a Durbin-Wu-Hausman test for endogeneity was performed suggesting consistency of the model specifications.

Limitations

Although aggregate data can certainly be used to study changes in market demand due to changes in, say, market size and income, a critique of this analysis would be that using world regions country-level data to make inferences about individual behavior would assume that all consumers within a jurisdiction have identical preferences.

Concluding remarks

This chapter attempts to contribute to the study of the aggregate behavior of lottery players worldwide. First, the empirical results reached confirm that lottery can be understood as a fickle form of finance to afford indivisibility expenses and that there are differences in lottery consumption among world regions. Additionally, the adopted allocation strategy of lottery funds to a particular public purpose (good cause) may, in some cases, affect the demand for lottery. Finally, it empirically shows that lottery is a normal good and as an implicit tax, regressive.

In particular, the empirical results suggest that per capita lottery expenditures are greater when lottery proceeds are allocated to either education or social activities. However, there seems to be a negative relationship between the money that goes to public purposes and the level of lottery sales. This may be explained by the fact that people do positively perceive the final destination of the money but are concerned about the amount – since the amount of money allocated to any public purpose is removed from the amount of money devoted to prizes.

Important policy recommendations that can be derived from this outcome would be that linking the lottery to a particular public purpose could serve as an argument to convince the government or society of supporting either its introduction or operation, and that perhaps lottery operators should invest more in marketing the end-use of the payments they make to society. In any case, a full explanation of the causal mechanism between aggregate lottery demand and the use of payments to society is still needed.

However, this chapter offers a further step in the literature of state lottery markets as it helps to better understand the role that funding allocation plays in terms of the demand

for lottery. It is also hoped that it serves as a guide for lottery researchers, regulators, and/or policymakers and legislators around the world, as it raises questions about the international distribution of lottery revenue and the implications of payments made to society.

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CHAPTER 2. THE MARKET OF EUROMILLIONS: SALES TRENDS, JACKPOT SENSITIVITY AND IMPLICIT TRANSFERS OF FUNDS AMONG COUNTRIES

Introduction

Within lottery markets one of the most remarkable phenomena has been the prevalence and scale of long-odds high-prize lottery products. This type of lotto games is frequently state-regulated and organized as pari-mutuel gambles where all bets of a particular type are placed together in a pool and payoffs are calculated by sharing the pool among all winning bets after deducting taxes and operational expenses. Governments worldwide have consequently authorized such lotto games based on the public's interest in them as an alternative method for the government to raise new revenue without raising taxes. However, in recent decades, the demand for lottery seems to face a stage of maturity and in some cases even of decline (Díaz and Pérez, 2021). As a response and attempt to revert this trend aiming to make playing more attractive, lottery operators across different jurisdictions started to operate multi-country lotteries, offering large prizes that would not be possible to generate operating separately. By exploiting "the peculiar scale economies of lotto" (Cook and Clotfelter, 1993) multi-country games combine the markets of the separate lottery jurisdictions which make up the new lottery market.

Following the North American successful experiences of Powerball (1992) and Mega Millions (2002), on February 7th, 2004 the EuroMillions game was launched by a joint venture of lottery operators from France (*Français des Jeux*), Spain (*Loterías y Apuestas del Estado*) and the UK (*Camelot*). Later, on October 8th, 2004, Austrian, Belgian, Irish, Luxembourgish, Portuguese and Swiss lotteries joint the EuroMillions market. On the basis of collecting funds from lottery players across all participating countries, the EuroMillions game was expected to offer jackpot prizes of a sufficient size to attract and increase the number of lottery players in a given country to an unachievable level by any domestic lottery game run in that jurisdiction.

Since its introduction, the EuroMillions game, like all pari-mutuel lottery products, has been designed to distribute a proportion of the sales revenue (50%) among different prize categories. Lottery operators allocate the remaining 50% to cover their corresponding organization costs (infrastructure, salaries, advertising, etc.) and to fund good causes, such education, sports, charities or cultural activities. In case nobody guesses the winning

combination in a particular draw, the amount of the jackpot prize rolls over the next draw, boosting the demand for the game. A bigger jackpot may cause current players to spend more but also it may make the game more attractive to new players who might enter the market. Following the seminal work of Forrest et al. (2002), such a positive relationship between jackpot size and lottery sales has been well documented in the literature (for some recent references, see, among others, Combs and Spry, 2019; Gabrielyan and Just, 2020; Díaz and Pérez, 2021; Polin et al., 2021).

Notwithstanding, although the increase in the demand for EuroMillions occurs to all operators of the game, it is however quite heterogeneous across countries. Roger (2011) analyzed 197 draws of EuroMillions game between 2004 and 2007 and found that sales response to jackpot size sharply differ among countries with a prize elasticity of the demand ranging between 0.6 and 0.9. Accordingly, it could be possible that sales increase more in certain countries than others, increasing sales share of high jackpot sensitive countries and so their odds of having a national winning player as well. Therefore, high jackpot sensitive countries could benefit from the funds that have been contributed to the prize pool by the rest of the countries throughout a particular draw cycle. If this is the case, when the jackpot is high those countries' players would be 'implicitly subsidized' from players in other countries within the EuroMillions market.

Previous research has focused on the regressivity issue when analyzing multistate lottery games. Using data on sales from Powerball, Oster (2004) found evidence of this kind of lottery products being less regressive at higher jackpot levels. In recent papers Han et al. (2016, 2017) also demonstrate, using data from Mega Millions, that regressivity reduces with the size of the jackpot. Finally, Comb and Spry (2019) estimates income elasticities to increase with the jackpot size in Powerball and Mega Millions games concluding these lotto games being regressive. However, as far as it is known, there is no particular contribution about implicit subsides among countries (or states) within this literature.

This chapter aims to analyze sales patterns of EuroMillions across countries focusing on market share trends and on whether implicit subsides among countries exist by studying the distributional consequences (across countries) of claimed jackpots. The potential regressivity character of the game is also analyzed. As far as it is known, there is no previous contribution in the literature analyzing the relationship between lottery sales market share and jackpot size and its implications on jackpot distribution. Indeed, there is no study on implicit subsidizing issues from jackpot wins distribution among countries in multi-country (or multi-state) lotteries.

EuroMillions: price, prizes and changes in game design

EuroMillions draw was held once a week, on Friday, until May 2011, when it was decided to increase the number of draws per week adding Tuesday as draw day. The price for a

single ticket has also significantly changed through time. Since September 2016 it is set at 2.5 euros, 2.5 GBP or 3.50 CHF depending on each country local currency. Nowadays the game is operated under a monopoly market structure in Belgium, the UK, France, Ireland, Portugal, Spain, Luxemburg and Austria, where there is only one lottery operator allowed to sell EuroMillions lottery tickets. That was also the case of Switzerland till 2011, since then tickets are sold by two lottery operators: *Swisslos* and *Loterie Romande*- the former operates the game in the cantons of German-speaking Switzerland and Ticino, while the latter operates in the French-speaking cantons Vaud, Friborg, Jura, Valais, Neuchâtel and Genéve.

As previously mentioned, EuroMillions is a pari-mutuel lotto type game where prizes are based on each draw sales level, and in which not claimed jackpots roll over to the next draw. The game consists in choosing five numbers from a matrix of fifty and two lucky stars (additional numbers) from a second matrix of twelve – 1 chance in 140 million of winning. Table 2.1 details the current prize structure of the game. Top right column shows the percentage of funds that are allocated to each prize category. It should be noted that for the jackpot prize category, the 50% of the prize pool is allocated for the first five draws of the cycle and it falls to 42% for the rest of the draws within a particular draws cycle.

Table 2.1. EuroMillions prize structure

Category	Correct Numbers		Probability of winning	Percentage Prize fund
	First matrix	Stars matrix		
1st	5	2	0.00000072%	50% or 42%
2nd	5	1	0.000014%	2,61%
3rd	5	0	0.000032%	0,61%
4th	4	2	0.00016%	0,19%
5th	4	1	0.0032%	0,35%
6th	3	2	0.0071%	0,37%
7th	4	0	0.0072%	0,26%
8th	2	2	0.10%	1,30%
9th	3	1	0.14%	1,45%
10th	3	0	0.32%	2,70%
11th	1	2	0.53%	3,27%
12th	2	1	2.03%	10,30%
13th	2	0	4.57%	16,59%

It should also be noted that a minimum prize of 17 million euros is guaranteed for the first draft of each cycle (it was 15 million euros until September 2016), being a cycle the successive drafts that took place until one player guesses the winning combination, or a “SuperDraft” is carried out. In 2016, the "Big Fridays" draws were introduced offering twice a year a guaranteed minimum prize of 120 million euros.

Just like there is a minimum prize, as for 2019 the prize structure also had a cap of 190 million euros (previously it was 185 million euros and even before it was 180 million

euros). Once the cap was reached, if there is no jackpot winner in the following draw, the corresponding amount will roll down and will be distributed among the winners of the next category.

Methods

EuroMillions data

Why use EuroMillions data? Even though there is a lot of other lottery data about, e.g., about the UK National lottery, effects of covariates like GDP or unemployment are confounded with secular trends. The nine countries operating EuroMillions have very different unemployment and socioeconomic contexts, giving a good handle on their effect. Baker et al. (2016) highlighted the relevance of modelling sales at regional level stating that it may help lottery operators providing them "guidance in understanding market trends. In addition, as lottery tickets are usually subject to tax, it is important to disentangle whether this tax increase is paid disproportionately by "disadvantaged regions".

Data on sales for EuroMillions were collected by operator in a draw-by-draw basis from the first draw in 2004 until the one held on December 3rd, 2019, resulting in a sample of 1,271 draws. Since not all the countries joined the EuroMillions market at the same time, observations for those draws when Spain, France and UK were the only participant countries were removed and so the first 34 draws of the game are not considered in this study.

Table 2.2. EuroMillions sales

Country	Average sales (million euros)	Average sales per capita (euros)
Belgium	4.578 (2.021)	0.412 (0.148)
UK	14.358 (7.952)	0.222 (0.124)
France	14.343 (6.709)	0.218 (0.104)
Ireland	1.482 (0.699)	0.321 (0.157)
Portugal	10.064 (4.990)	0.101 (0.469)
Spain	13.275 (4.076)	0.284 (0.088)
Switzerland	4.014 (1.620)	0.498 (0.213)
Luxembourg	0.403 (0.140)	0.748 (0.296)
Austria	3.075 (1.238)	0.359 (0.143)

Notes: Standard deviation in brackets. Sales figures were deflated by each country consumer price index to transform them in real terms. Consequently, this variable is measured in euros of 2015.

With respect to the among-country variability of EuroMillions sales, Table 2.2 shows the average sales and average sales per capita in each country (including autonomous cities) from 2004 to 2015. The overall average is 7.330 million euros, with four countries (UK, France, Portugal and Spain) having a particularly high average (well above 10 million euros). These four countries account (on average) for almost the 80 per cent of each draw sales.

Figure 2.1 plots each country sales share for each draw within the sample. A significant variation is observed among countries which also exhibit different patterns through time. The evidence from Table 2 and Figure 1 shows that sales for EuroMillions have enough variability in both dimensions to allow to distinguish between temporal and geographical effects.

Figure 2.1. EuroMillions market share (per country)

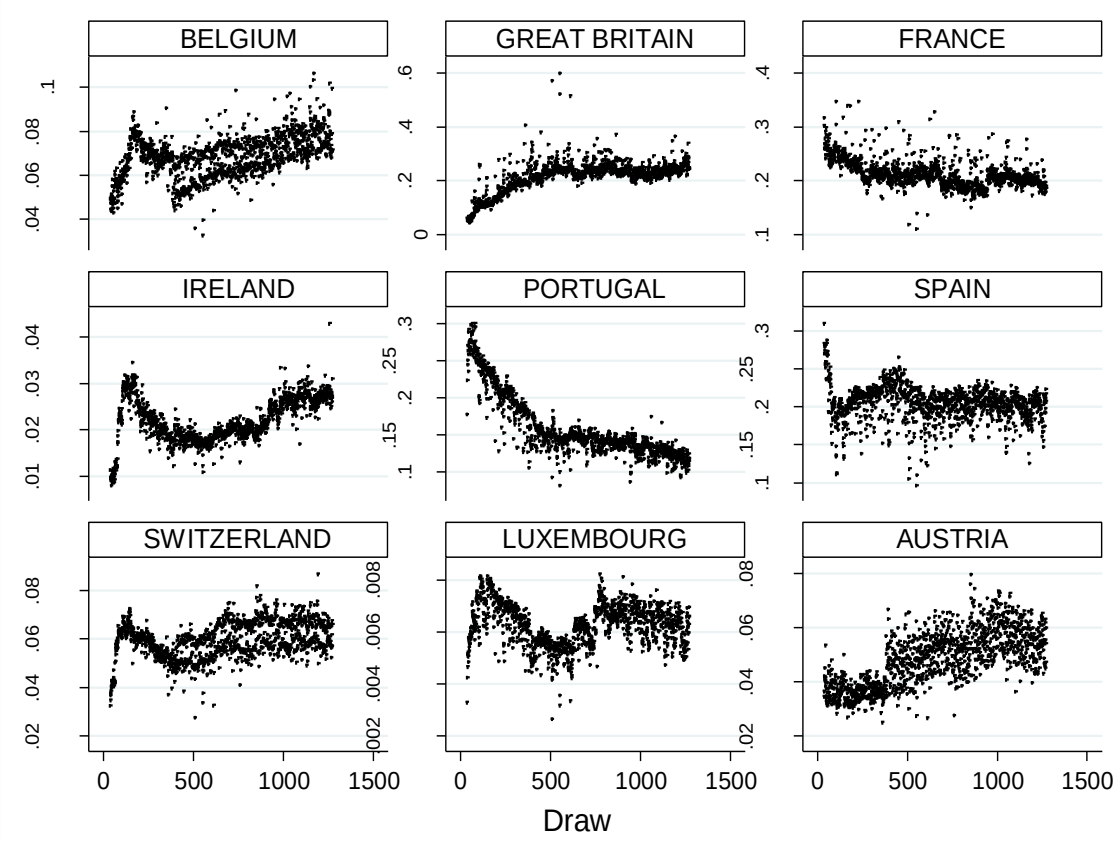
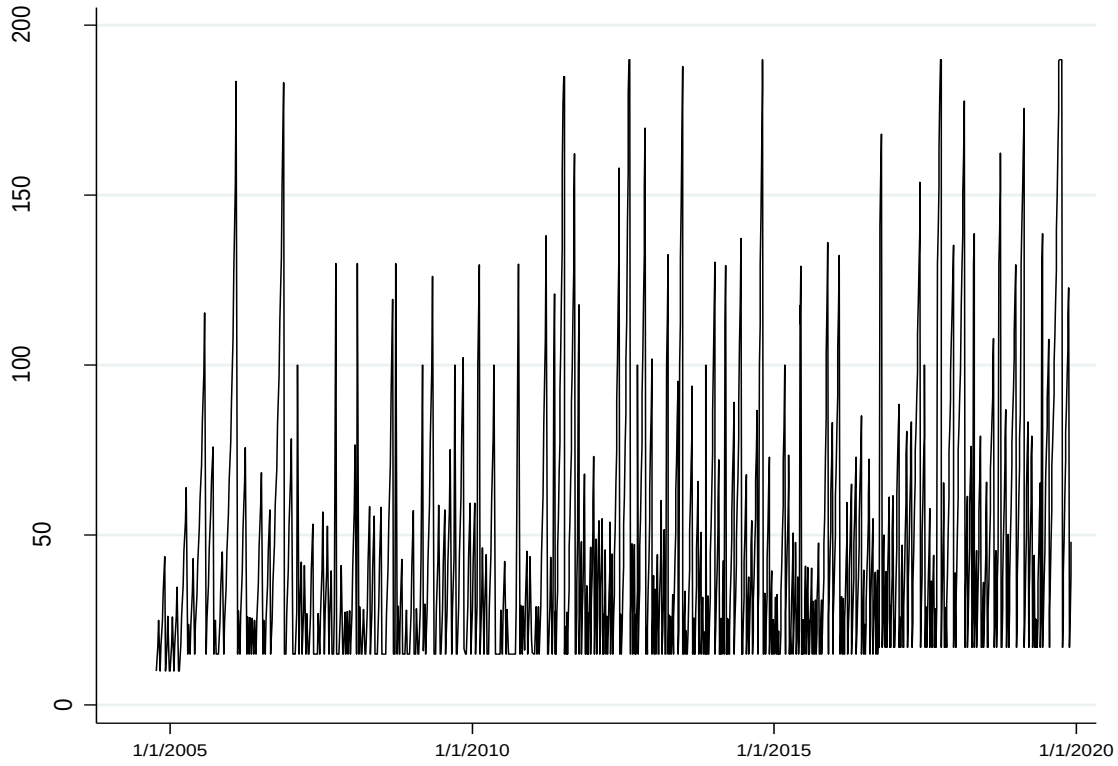


Figure 2.2. EuroMillions jackpot



As for the jackpot size, Figure 2.2 shows the EuroMillions jackpot values for the analyzed sample period, where a great volatility can be observed. From 2004 to 2019, the average jackpot was 48.7 million euros and the maximum jackpot reached was 190 million of euros (the limit set by the game rules).

Socioeconomic context

It is expected that EuroMillions sales respond to changes in market socioeconomics, such as each country GDP (income) and the population (market size). But also to other socioeconomic variables including the unemployment rate, the education level, and the average age by gender per country which are expected to somehow affect the demand for lottery tickets. Particularly, some previous studies found an ambiguous relationship between unemployment and lottery sales, even no correlation was found (DeBoer, 1990; Oster, 2004). Thus, some papers, including Mikesell (1994) and Scott and Garen (1994) concluded that unemployment has a positive effect on lottery tickets sales, while others, e.g. Blalock et al. (2007), found a negative relationship.

As for relationship between the education level (here the percentage of population with tertiary - highest level - education) and lottery sales, a number of contributions including Clotfelter and Cook (1987 and 1989), Kitchen and Powells (1991) and Farrell and Walker (1999) concluded that a negative correlation exists. However, in a more recent contribution, Han et al. (2016) contradicts these results finding a positive relationship.

About age and gender, Brochado et al. (2018), using data from Portugal, concluded that elderly people tend to buy tickets of "more traditional" lotto games. Moreover, they found that lotteries, including EuroMillions, are played more by men than women, with financial reasons as main driver of the demand.

Basic descriptive statistics of the considered socioeconomic variables are reported in Table 2.3. Throughout the analyzed period, economies from the countries playing EuroMillions exhibit significant heterogeneity in terms of socioeconomic factors. Income levels (measure here as quarterly GDP per capita) in Switzerland or Luxembourg are clearly above the rest of countries, while Spain and Portugal have the lowest GDP per capita figures. In terms of population, data suggests that UK, France and Spain would be expected to concentrate sales of EuroMillions lottery tickets as account for 80% of market size (almost 220 million inhabitants). Unemployment rates range between 5 and 10%, except for those countries that seem to have suffered most from the recent economic crises, such as Spain and Portugal, and, to a lesser extent, Ireland. A similar picture emerges for all countries regarding the percentage of population with tertiary (highest level) education (with the exception of Portugal) and the age structure of the population.

Table 2.3. Socioeconomic context (mean values)

Country	Quarterly GDP[a] per capita (euros)	Population (millions)	Unemployment rate (%)	Education level[b] (%)	Average age (male)	Average age (female)
Belgium	8.965	11.111	7.547	32.035	42.274	39.986
	(0.871)	(0.30)	(1.034)	(2.757)	(0.434)	(0.479)
UK	8.697	64.211	5.823	34.996	40.744	38.577
	(0.823)	(1.911)	(1.529)	(4.233)	(0.545)	(0.395)
France	8.090	65.903	9.386	28.835	41.907	39.026
	(0.535)	(1.295)	(0.914)	(3.110)	(0.966)	(0.903)
Ireland	12.342	4.682	9.629	36.282	35.891	35.044
	(3.068)	(0.192)	(4.050)	(4.275)	(1.408)	(1.453)
Portugal	4.364	10.426	11.522	17.994	44.155	41.023
	(0.412)	(0.107)	(3.438)	(4.078)	(1.790)	(1.801)
Spain	5.871	46.278	18.458	30.762	42.583	40.331
	(0.410)	(0.854)	(5.618)	(2.770)	(1.648)	(1.798)
Switzerland	16.438	8.106	4.69	32.238	42.772	40.806
	(2.618)	(0.339)	(0.412)	(4.254)	(0.731)	(0.653)
Luxembourg	21.677	0.548	5.446	33.181	39.641	38.455
	(2.571)	(0.047)	(0.702)	(5.836)	(0.286)	(0.489)
Austria	9.657	8.548	5.186	22.613	43.529	40.949
	(0.978)	(0.212)	(0.615)	(6.651)	(1.143)	(0.993)

Notes: Standard deviation in brackets. [a] GDP is measured in euros of 2015. [b] Percentage of population with tertiary (highest level) education.

Empirical model: Understanding EuroMillions market share trends

The available information has a panel data structure which allows observing both EuroMillions lottery tickets sales and sales market share at the country level. First, a simple model for sales, with country and draw fixed effects and socioeconomic variables as covariates is estimated. Sales of EuroMillions draws at country level is considered as the outcome variable and the following specification is estimated by using the within-group estimator which allows to control for the correlation of the unobserved effects at the country level and the explanatory variables:

$$ln\, Y_{itj} = \alpha_i + \gamma P_t + \beta X_{ij} + \tau T_t + \mu DW_t + \theta J_t + u_{it} \quad (2.1)$$

where Y_{itj} is the EuroMillions sales per capita in country *i* in draw *t* of year *j*; α_i stands for the country fixed effects; P_t is the price of single ticket (the same in euros for all countries); X_{it} is a vector of the previously described covariates that could affect the outcome variable (GDP, population, unemployment rate, education level, and the average age by gender); T_t captures the time trend (number of draw) which allows the study to control for the effect of factors that may have simultaneously affected EuroMillions demand in all countries (this was modelled as a cubic in time); DW_t is a dummy variable to indicate week-day draw; J_t is the natural logarithm of the jackpot size in each draw; and u_{it} is the error term. Notice that the parameter of interest, measuring jackpot sensitivity is θ. Using a Hausman's test we reject the null hypothesis of no correlation between the individual effects and the explanatory variables. This justifies the use of the within-group estimator.

Second, in order to estimate how EuroMillions market share varies across countries (use of ratio of sales avoids a lot of noise in the data) a fractional outcome probit model is estimated. Using quasilikehood estimators, fractional regressions model the mean of the dependent variable, each country market sales share here, conditional on the aforementioned set of covariates (Papke and Wooldridge, 1996, 2008):

$$Y_{itj} = \Phi(\alpha_i + \gamma P_t + \beta X_{it} + \tau T_t + \mu DW_t + J_t\ \theta + u_{it}) \quad (2.2)$$

where Y_{it} is the sales share in country *i* in draw t of year j; α_i is the individual (country) effect; P_t is the price of single ticket (the same in euros for all countries); X_{it} is a vector of covariates that could affect the outcome variable; T_t is a dummy variable capturing the time effect which allows the study to control for the effect of factors that may have simultaneously affected EuroMillions demand in all countries; DW_t is a dummy variable to indicate week-day draw; J_t is a vector the natural logarithm of the jackpot in each draw; and u_{it} is the error term.

Results

Table 2.4 shows the estimated coefficients for both the fixed effects model and the fractional outcome probit model. As explained, sales of EuroMillions tickets depend on jackpot size, but also contribute to jackpot pool, so prizes are based on a percentage of sales revenue. For this reason jackpot is instrumented on size of real rollover. In this case, two-stage procedure allowed for endogeneity of jackpot. This method was proposed by Gulley and Scott (1993) as conventional means of modelling lotto demand. The first column reports the estimation results of the specification in Equation (2.1), where the dependent variable is the log of the EuroMillions per capita sales. Overall, the estimated jackpot elasticity of the demand for EuroMillions is 0.182. In order to disentangle whether some differences among countries exist, the model in Equation (2.1) is re-estimated but including interaction terms between the jackpot size and a set of country dummies. Results in the second column show that Austria and the UK are the highest jackpot sensitive countries with an estimated jackpot elasticity exceeding 0.25, while Portugal and Luxembourg exhibit the lowest jackpot elasticities. These results are in line with those of Roger (2011), who found the demand for EuroMillions to be much less sensitive to the jackpot size in Portugal than in UK.

As for the market share model specifications, results from the fractional outcome probit model are reported in the third column. As previously discussed, although the jackpot size positively impacts the demand for EuroMillions lottery tickets in all jurisdictions, some countries experience an increase in their market share to the detriment of others, producing a significant change in the demand distribution across countries. From Table 2.4, it can be observed that high jackpot sensitive countries are those increasing their market share (UK, Austria, Ireland and Belgium), while other countries, including Portugal, Luxembourg and Spain see their market share shrinking.

Although it is aimed to provide an insight into sales patterns of lottery tickets and market share trends within the market for EuroMillions, the results of the control variables included in all model specifications in Table 2.4 are also commented. Since the model we are estimating corresponds to a demand equation, we included, as previously mentioned, a proxy for the income at the country level (GDP), a variable capturing the size of the market (population) and other socioeconomic variables (monthly unemployment rate, a proxy of the education level and the average age per gender and year), all of them having geographical and time variation. To account for time-effects, all model specifications also include categorical variables for the year, the day of the week in which every draw in the sample takes place and a cubic time trend (draw number). The price of a single ticket is also included in all model specifications.

In line with previous evidence, each country GDP per capita positively affects both lottery sales and market share. Particularly, the results for the sales model specifications show a significant effect for the GDP per capita, with an elasticity clearly below one (i.e., EuroMillions is a normal good). In addition, the estimated income elasticities show, as in Clotfelter and Cook (1991), that sales revenue increase less than proportionately with income (GDP), which makes EuroMillions, as an implicit tax, regressive. It is worth note that estimated income elasticities for EuroMillions are lower than those estimated by Oster (2004) using data from Powerball. As for the size of the market (population), a negative effect is found for all specifications. With regards to the age of the population, increases in males age tend to reduce per capita sales of EuroMillions sales, meanwhile opposite results are found for females age (see Barnes et al., 2011 for a detailed discussion on the age pattern for lottery gambling).

Table 2.4. Estimates of the lottery sales and market share models

	Sales[a]		Market share
	(I)	(II)	(III)
Jackpot size			
Jackpot (log of)	0.182***		
Belgium*Jackpot		0.175***	0.001***
UK*Jackpot		0.256***	0.006***
France*Jackpot		0.146***	-0.001*
Ireland*Jackpot		0.175***	0.003***
Portugal*Jackpot		0.109***	-0.007***
Spain*Jackpot		0.175***	-0.005***
Switzerland*Jackpot		0.198***	0.012***
Luxembourg*Jackpot		0.103***	-0.007***
Austria*Jackpot		0.296***	0.007***
Country socioeconomics			
GDP	0.019***	0.018***	0.003***
Population	-0.001***	-0.001***	0.001***
Unemployment rate	-0.002***	-0.002***	-0.003***
Education level	-0.011*	-0.013***	0.020***
Age (male)	-0.537***	-0.531***	0.043***
Age (female)	0.444***	0.433***	-0.121***
Other controls[b]			
Constant	YES	YES	YES
Price of a single ticket	YES	YES	YES
Country dummy	YES	YES	YES
Week-day dummy	YES	YES	YES
Year dummy	YES	YES	YES
Trend (cubic)	YES	YES	YES
Observations	11125	11125	11125

Notes: [a] Dependent variable is in logs; R2 is 0.862 (model I) and 0.866 (model II) respectively. [b] In the case of Switzerland, a dummy variable is included to control for the period during which there are two lottery operators running the game. **significance at 10%; ** significance at 5%; *** significance at 1%.*

About the unemployment rate, a negative effect on lottery sales is observed. This is in line with Blalock et al. (2007), while contradict findings in Mikesell (1994) and Scott and Garen (1994). Oster (2004) also found a negative, but no significant, effect of unemployment when analyzing Powerball sales.

Against Han et al. (2016), the estimated coefficient for education level is negative in all specifications, indicating that higher level of education negatively impacts the consumption of this kind of lottery game. This may be related to the implicit bias in the complexity of calculating the winning odds linked to this type of gambles.

Overall, demand for EuroMillions is found to be sensitive to socioeconomic conditions, while other studies suggest domestic lotteries are stable.

Discussion: A further insight into implicit transfers of funds issues among countries

As sales increase more in certain countries (high jackpot sensitive countries) than in others, therefore increasing their market share, it could be expected that these countries' chances of having a national winning player would also increase. High jackpot sensitive countries could then benefit from the funds that have been contributed to the prize pool by the rest of the countries along a given draw cycle. This could raise some implicit transfer of funds issues, should some countries demand be more sensitive to the jackpot size and therefore these countries more likely to win the jackpot than other countries within the EuroMillions market. In order to check on this, first the probability of a particular country winning the jackpot is estimated using a probit model approach, where the natural logarithm of the jackpot size and draw related controls (day of the week and time trend) are the unique considered covariates.

Table 2.5. Probability of hosting a jackpot winner

Country	Jackpot size	
	Coefficient	Marginal effect
Belgium	0.245***	0.015***
UK	0.293***	0.033***
France	0.086***	0.009***
Ireland	0.308***	0.008***
Portugal	-0.050	-0.04
Spain	0.027	0.003
Switzerland	0.287***	0.009***
Luxembourg	0.117	0.001
Austria	0.131***	0.004***

Notes: Controls include draw day of the week and time trend. *** *significance at 1%.*

Results in Table 2.5 show significant differences across countries. While Belgium, UK, France, Ireland, Switzerland and Austria see their odds of hosting a jackpot winner raise as jackpot size increases, others do not experience significant effect.

Second, the amount of the jackpot prize distributed across countries within the EuroMillions markets and their corresponding payout rate, the amount of euros received per euro wagered, are analyzed (Table 2.6).

In absolute terms, the UK has received the most from the jackpot pool, followed by Spain and France, while Luxembourg and Austria are the countries that have received the less. As expected, the three countries that have received more funds from the jackpot wins (UK, Spain and France) are also the three countries that concentrate the most of the market size (population) leading the demand for EuroMillions lottery tickets during the analyzed period.

Notwithstanding, one would expect that countries receive their 'fair share' of jackpot wins given their contribution to aggregate sales, i.e. the payout rate would be similar across countries. However, because the sensitivity of certain countries sales to jackpot size is particularly high (see Table 2.4), then it would be expected that their jackpot wins would be disproportionately likely to be in high payout draws (Baker et al. 2016).

Table 2.6. EuroMillions sales, jackpot wins' distribution across countries and payout rate

Country	Jackpot received (million euros)	Sales (million euros)	Jackpot payout rate
Belgium	1395.8	5844.3	0.239
UK	4313.9	18393.2	0.235
France	3014.8	18340.9	0.164
Ireland	825.6	1860.3	0.444
Portugal	2186.2	13633.9	0.160
Spain	3367.1	16794.9	0.200
Switzerland	909.3	4929.1	0.184
Luxembourg	97.4	523.1	0.186
Austria	482.6	3934.9	0.123

Such indeed has been the case. Ireland is by far the country that has the highest jackpot payout rate (0.44 euros per euro staked), even though it is located near the bottom of the

sales ranking. Also, Belgium and the UK show a payout rate over the average. It seems likely therefore that the greater willingness of these countries' players to increase their purchases when the jackpot is high will have generated relatively frequent headline-making payouts to these countries noted an ‘implicit subsidy’ to these countries’ players from players in other countries.

Concluding remarks

Lottery operators worldwide have seen multi-country lotteries as a possible solution to the drop in sales of traditional lottery games operated in national markets. Following the success of multi-state lotteries in North America, nine European countries agreed to launch the EuroMillions game in 2004 as the first European multi-country lottery game.

Using data at a country level, this paper analyzed sales and market share trends in the market for EuroMillions lottery tickets over a period of 1237 draws. The focus was on studying whether different sales trends across participant countries exist, whether market shares respond to the jackpot size, and on analyzing the implicit subsidies among countries as a consequence of the distribution of the jackpot wins.

Results from a panel data regression suggest that the demand for EuroMillions lottery tickets across countries differently react to jackpot size. Specifically, jackpot-elasticity of EuroMillions demand vary from less than 0.1 (Portugal and Luxembourg) to more than 0.25 (UK and Austria), allowing to distinguish high jackpot sensitive countries. However, while jackpot size positively influences the demand for EuroMillions lottery tickets in all jurisdictions, one interesting feature in the evolution of the game has been the extent to which trends in sales market share have differed across the nine member countries. Thus, it is shown that some countries experience an increase in their market share to the detriment of others, resulting in a significant demand distribution change among countries. As a result, high jackpot sensitive countries might also increase the odds of hosting a jackpot winner.

A deeper analysis of how these variations in the market share and winning odds per country and draw affects jackpot wins distribution shows that countries that increase their lottery sales when the jackpot increases also claim higher jackpots and achieve higher payout rates. This could be interpreted as the greater willingness of some country players to increase their purchases when the jackpot is high have had generated relatively frequent headline-making payouts to these countries noted as an ‘implicit subsidy’ to these players from players in other countries.

In line with previous literature on lottery markets, evidence is also found that income positively affects EuroMillions lottery sales, but with an income elasticity clearly below one, indicating that EuroMillions could be also understood as an implicit tax, regressive.

Some policy recommendations might be derived as to creating some mechanism (e.g. by way of a compensation fund) to allocate more funds to countries with lower payout rate, redistributing part of EuroMillions revenues between these countries that systematically received less from the jackpot pool. These funds could be earmarked to good causes, such as education, sport, etc. The results could also be further explored in the context of choice of game design. Game design could exploit sales market share pattern by seeking to induce a pattern of wins that would typically (in the larger countries) produce a national winner at more appropriate intervals.

Finally, national media coverage could give more information on the game to a much wider audience than those who seek out the official results in those countries with lowest payouts; so, there could be a greater sales response to increases in the jackpot size. An advertising effect to boost demand may work simply by reminding the public about that buying a single ticket just might change their life.

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CHAPTER 3. HOUSEHOLD STRUCTURE DECISIONS AND POSITIVE WEALTH SHOCKS: A NATURAL EXPERIMENT

Introduction

The wealth effect is an economic phenomenon that explains the increase in consumer spending when real monetary balances and, therefore, consumer wealth increase. Indeed, there is an extensive empirical literature addressing the positive relationship between wealth and consumption (back to Ando and Modigliani, 1963) both from the macro and microeconomics perspective (see the review by Altissimo et al., 2005). In addition, it can even be considered that the very feeling of security in their financial situation may encourage individuals and household to make choices that are different from those that they would make if they did not experience such an increase in wealth. Beyond the aforementioned and well-known relationship between wealth and consumption, this paper aims to analyze the association between a household wealth and/or exogenous economic conditions and the structural decisions that affect the composition of the household itself.

It is commonly known that household often spend a lot of resources (e.g., time) making decisions that will affect their own structure over a long period of time or even over a lifetime (e.g., getting married, getting divorced and/or having children, among others). However, a number of factors can make household members change their mind and indeed decide faster, including exogenous and unexpected changes in wealth and environmental economic conditions. In fact, empirical evidence has shown that exogenous wealth shocks could affect individuals' health, happiness, and life satisfaction (Adda et al. 2009; Apouey and Clark 2015; Hankins et al. 2011; Lindhal 2005) and hence their behavior, their lifestyle choices, and the lifelong decisions that they make.

Nevertheless, given that household wealth can be affected by the household structure and financial position as well as determining both, and that variations in economic conditions could produce some potential endogeneity, the isolation of the effect of wealth on household decision making can be eased by estimating how household decisions change if a positive exogenous wealth shock is received either directly or through a change in the surrounding economic conditions. Previous literature has addressed this issue by using lottery winnings as a proxy for such random wealth shocks. Imbens et al. (2001) used lottery winnings to study the effects of wealth shocks on the labor supply, earnings, savings, and consumption decisions, while Hankins and Hoekstra (2011) found that gaining wealth (large income shocks) from the lottery significantly reduce the likelihood

that single women marry. In contrast, it has no effect on neither marriage rates of men nor the number of divorces. Additionally, Kuhn et al. (2011), using a natural experiment associated with the Dutch postcode lottery, found that the effects of a temporary unexpected income shock (lottery prize) are limited to cars and other consumer durables.

In this chapter, the Christmas draw of the Spanish National Lottery (the so-called *El Gordo*, referring to the huge jackpot offered—*El Gordo* is Spanish for "the fat one" or "the big one") is used as a natural experiment to proxy positive wealth shocks (here, random exogenous variations in annual provincial wealth). The focus is on exploring whether the fact that the Christmas draw's winning tickets are sold in a particular province affects the number of marriages or divorces and the number of births in that province. The unit of analysis is established at the provincial level because this is the minimum level of aggregation that provides all the necessary information about the variables included in the empirical analysis.

The use of *El Gordo* to represent exogenous variation in wealth across geographical areas (here provinces) is not new. Bagues and Esteve-Volart (2016) explored the source of the correlation between the votes received by incumbent politicians and the economic conditions, exploiting the evidence provided by the Spanish Christmas lottery. Bermejo et al. (2019) also used the Spanish Christmas lottery winnings to estimate the effect of income shocks on entrepreneurship. In both cases, the key assumptions behind the use of this instrument are that the winning province/s is/are randomly assigned, winners tend to be geographically clustered (Bagues and Esteve-Volart 2016), and, for each of the analyzed periods, a winning province can receive a monetary shock equivalent, on average, of up to 5.28 percent of the median GDP of the Spanish provinces in 2017.

Background to the Spanish Christmas lottery draw

The Spanish Christmas lottery draw could be considered as a unique lottery since 75 percent of Spaniards play and the sales revenue reaches 0.3 percent of the Spanish GDP (Bagues and Esteve-Volart 2016). It takes place every year on December 22 and, with the exception of some multi-state lotto games in the United States (e.g. Powerball and Mega Millions), it is the largest lottery draw in the world, offering a jackpot of 688 million euros in the 2020 edition. This prize, which is the total amount of the jackpot prize that would correspond to all the issued tickets with the winning number, is usually spread among a large number of people (up to 1,720 winners can win 400,000 euros each). If all the tickets are sold, the total of the issuance amounts to 3,440 million euros, of which around 2,408 million are allocated to prizes (the payout rate is 70 percent).

The Christmas lottery is really a national event in Spain in which society is involved in terms of individual purchases and syndicate play (Garvía 2007). Lines of people waiting to buy a ticket in some "lucky stores" (Guryan and Kearney 2008) are becoming more

and more common. It should be noted that tickets may become available as early as July each year.

Although the operator introduces changes into the characteristics of the draw with each new edition, it is based on tickets that have 5-digit numbers (ranging from 00000 to 99999), just like any regular draw of the Spanish National Lottery. The particular numbers that are allocated to each outlet are randomly determined (Bermejo et al. 2019).

Due to the enormous popularity of the game, each set of numbers on each of the tickets is sold multiple times; in several so-called "series" (the last edition of the draw in 2020 had 172 series for each of the 100,000 tickets). Between the series, there is no difference in prize money. That is, a prize on a 5-digit number is paid on that number in every unit. Therefore, the series number is merely an administrative one. The price of an entire ticket costs 200 euros for each "serie." Because this may be too expensive, the tickets are usually sold as tenths (the price of a tenth is then 20 euros).

The jackpot prize amounts to 4 million euros for each "serie" of the winning number (400,000 euros for the tenth), which is equivalent to a return of 20,000 euros of prize money for every euro staked. A winning ticket (20 euros) may therefore receive more than the average wealth of a Spanish household (274,000 euros). There is also a second prize of 1.25 million euros (125,000 euros for the tenth) as well as a third prize of 500,000 euros (50,000 for the tenth). In addition, there are many other small prize categories. Due to data availability reasons, the focus is merely on the first (jackpot) prize.

Finally, it should be mentioned that since 2013, any area of the prize exceeding 2,500 euros is susceptible to a tax rate of 20%. So prizes of 2,500 euros or less are tax exempt. For prizes in excess of this amount, tax is payable on the portion that exceeds 2,500 euros. In all cases, prizes are paid immediately, in a unique payment.

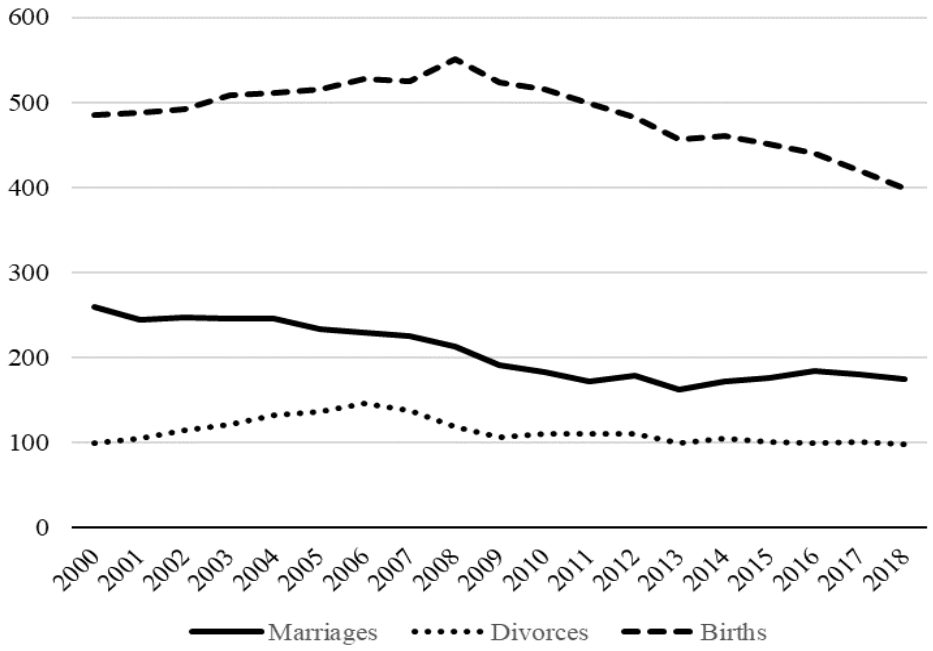
Data and model specification

Information on the previously mentioned variables related to household structure decisions (number of marriages, number of divorces and number of births) at the province level is collected by year for each of the 52 provinces of Spain between 2000 and 2018. Each of them is expected to have enough variability in both dimensions to allow us to distinguish between temporal and geographical effects.

To provide a further description of the above-listed dependent variables, Figure 3.1 describes the evolution of marriage, divorce and birth rates over the period 2000–2018. It can be noticed that the marriage rate has been in continuous decline in Spain in recent years. Besides the generalization of cohabitation as an alternative to marriage (Hiekel and Castro-Martín 2014), this pattern could also be explained by economic conditions, such

as the recent evolution and deteriorating situation of the Spanish labor market. According to the Spanish Statistical Office, in 2018, the unemployment rate in Spain was 15.25 percent; today, Spain has the second-highest unemployment rate of all the EU states, which may affect and contribute to the delay of the marriage decision (De la Rica and Iza 2005; Gutiérrez-Domènech 2008; González-Val and Marcén, 2018). Even though a rise in the divorce rate can be observed in the early 2000s, it seems to exhibit a steady flat trend in recent years. In this aspect, Bernardi and Martínez-Pastor (2011) discussed how divorce risk factors have changed over time in Spain and González-Val and Marcén (2018, 2020) indicate the different effects of gender unemployment rate on divorce rates. Regarding births, the declining trend in fertility (and thus the birth rate) over the last decade has been particularly evident in southern European countries, which were strongly affected by the financial crisis of 2007–2008 and which present a high rate of unemployment and precariousness (Matysiak et al. 2021). In this aspect, Bellido and Marcén (2019) studied the economic behavior of the fertility rate for thirty European countries from 1993 to 2013, suggesting a procyclical pattern.

Figure 3.1. Marriage, divorce and birth rates in Spain (2000–2018)

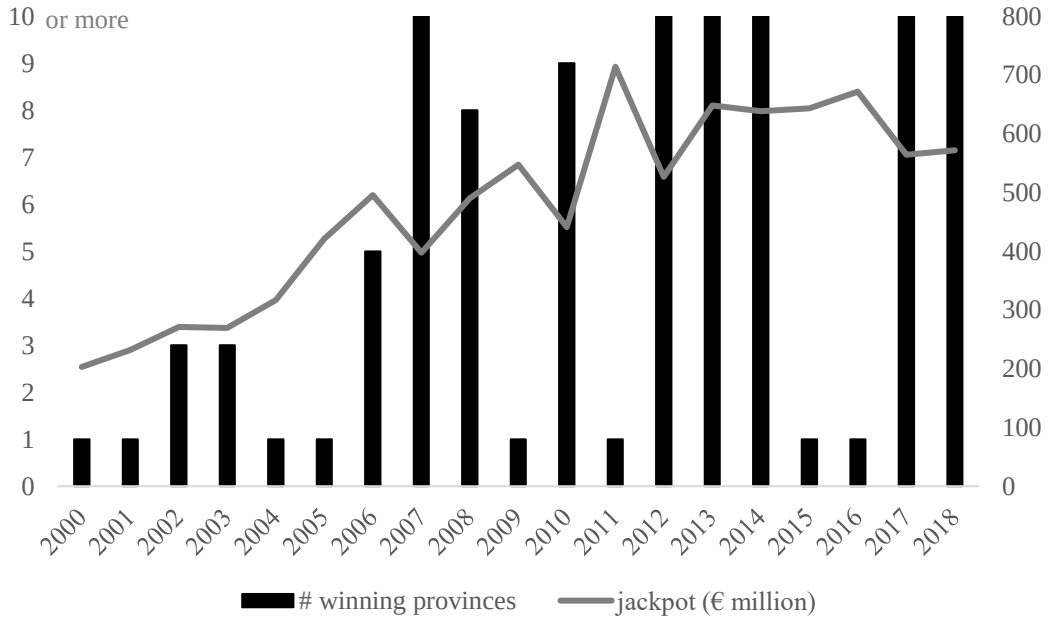


As the main covariate, an indicator of whether there has been a random wealth shock in a given province is created based on information from the Christmas lottery. Figure 3.2 shows the number of provinces winning at least a portion of the jackpot prize with the corresponding prize amount. The *winning provinces* are identified by the location of the sales points that sold the winning tickets since most prizes are collected in the province where the tickets were sold (Bermejo et al. 2019). This is apparently a strong assumption since some lottery players may acquire tickets from other provinces either by exchanging or sharing tickets with relatives or people in their social networks or by directly purchasing lottery tickets outside their province of residence, among others. Bagues and

Esteve-Volart (2016) empirically supported such an assumption, concluding that Christmas lottery winners tend to live mostly in the same province as the lottery tickets were sold.

On the basis of the information collected, also a dummy variable for a winning province is then created and coded as one when all the winning tickets are sold in that unique province—the *only-winning province*. Accordingly, up to 1,720 individuals in an *only-winning province* are expected to collect 400,000 euros each (on aggregate, such a wealth shock exceeds 5 percent of the median GPD of Spanish provinces in 2017). Because Christmas lottery players often play in a syndicate (Garvía 2007), sharing lottery tickets, this figure should be considered as a lower bound of the number of individuals receiving lottery winnings.

Figure 3.2. Number of winning provinces and jackpot prizes (2000–2018)



In addition, for an *only-winning province*, exogenous good economic conditions are generated that may produce a temporary overall increase in happiness of that province's inhabitants, including non-lottery players - and so affect household structure decisions, even when the number of lottery winners might be limited to a relatively small number of people.

The available information has a panel data structure, which allows us to control for changing socio-economic and demographic conditions among provinces and for the effects of unobserved variables. Accordingly, macroeconomic and social information for the mentioned period is gathered from multiple public access databases to control for the characteristics of provinces that can affect household decision making. This gives the

following covariates for inclusion in the model: the real GPD (measured in euros with the purchasing power of 2016) (income effect), the population (market size), the ratio of foreign population (to control for the population's social structure and to try to capture social trends, such as the effect of the migrant population's evolution), the ratio of the population with higher education (as a proxy for human capital), the unemployment rate by gender (to allow a comparison of the effects of male and female unemployment on family structure decisions), and year fixed effects (to control for possible time-dependent effects).

Table 3.1. Source of the data

Variable information	**Source**
Christmas lottery—*jackpot-winning provinces*	Sociedad Estatal Loterías y Apuestas del Estado (Spanish for "State Society for State Lotteries and Bets," SELAE)
Households' decisions	
Household structure—*number of marriages, number of divorces, number of births*	Spanish Statistical Office (INE)
Macroeconomic controls (province level)	
Population and foreign population	Spanish Statistical Office (INE)
GDP	Spanish Statistical Office (INE)
Consumer Price Index	Spanish Statistical Office (INE)
Population with higher education—*human capital*	Valencian Institute of Economic Research (IVIE)
Labor market—*unemployment*	Spanish Statistical Office (INE)

Because of limited available information - information on real GDP by province is available only for 2000–2017; information of unemployment rate (male and female) is available only for 2002–2018 – the data sample used in the empirical part of the study is made of 832 observations going from 2002 to 2017. Table 3.1 reports the source of each considered variable, and basic descriptive statistics of the variables are shown in Table 3.2.

Table 3.2. Summary statistics for the key variables

	Obs.	Mean	Std Dev.	Min.	Max.
Dependent variables					
# marriages	988	3,595.248	4,855.045	236	30,185
# divorces and separations	987[a]	2,181.905	3,130.733	94	21,052
# births	988	8,569.141	11,952.940	586	78,646
Lottery variables					
El Gordo jackpot (€ thousand)	988	556,799.340	140,008.627	203,042.570	714,211.200
Winning provinces[b]	988	8.368	11.194	1	45
Jackpot-winning provinces[c]	988	0.008	0.090	0	1
Macroeconomic variables					
GDP (€ million)	936[d]	18,901.677	30,440.620	936.429	211,511.051
Population (thousand)	988	868.568	1,097.523	65.488	6,578.079
Foreign population rate (%)	988	0.077	0.055	0.003	0.243
Higher-education population rate (%)	988	16.812	4.678	7.163	31.675
Male unemployment rate (%)	884[e]	14.409	8.125	1.688	40.283
Female unemployment rate (%)	884[e]	19.289	8.293	3.5	47.925

Notes: # stands for "number of." [a] Information for *Ceuta* in the year 2015 is not available. [b] Provinces winning at least a portion of the jackpot prize. [c] All winning tickets are sold in a unique province.

To check on the randomness of winning provinces a panel data probit model is estimated in which the variable to be explained is the probability of a province to be classified as an *only-winning province* (as described above). The explanatory variables include the following macroeconomic variables: GDP, population, the ratio of the population with higher education and the unemployment rate. Estimates from Table 3.3 show that province characteristics do not predict the probability of an *only-winning province*.

Table 3.3. Panel data estimates (probit model)

Dependent variable is the probability of a *jackpot-winning province*

	Jackpot-winning province
Macroeconomic variables	
GDP	1.32e-11 (1.19e-11)
Population	-9.38e-08 (3.24e-07)
Higher education (rate)	-2.832 (3.982)
Unemployment (rate)	-0.016 (0.027)
Provinces	52
Number of observations	832

Notes: Robust standard errors are reported in parentheses. None of estimated coefficients is statistically significant from zero.

As previously stated, a panel data model with the following specification is used for the different estimations based on the alternative definitions of the dependent variable:

$$Y_{it} = \alpha_i + \beta X'_{it} + \tau DT_t + \theta DP'_{it-k} + u_{it} \quad (3.1)$$

where Y_{it} is the outcome variable (number of marriages, number of divorces and number of births) for province *i* in year *t*; α_i is the individual (provincial) effect—the inclusion of provincial fixed effects take care of all unobservables that cause different levels on the dependent variable in each province; X_{it} is a vector of covariates that could affect the outcome variable; DT_t is a dummy variable capturing the time effect which allows the study to control for the effect of factors that may have simultaneously affected household decisions in all provinces; DP_{it-k} is a vector of dummy variables for the *only-winning province*, taking the value one when all the winning tickets from the Christmas draw in year *t-k*—when k=1,2—are sold in province *i* and zero otherwise; and u_{it} is the error term. Since the Christmas lottery draw takes place on December 22 every year, the effect on the dependent variable of year *t* is estimated from the jackpot variable in year *t-k*. Two lags are taken into account to capture possible multiplier effects of the wealth shock received. Notice that the parameters of interest, measuring the effect of *El Gordo* in the analyzed household structure decisions, are θ.

Empirical analysis and results

In accordance with both the nature of the data and the definition of the dependent variables, a fixed-effect estimator is used to control for the correlation of the unobserved effects at the province level and the explanatory variables. Using a Hausman (1978) specification test, we reject the null hypothesis of no correlation between the error terms and the regressors. This justifies the use of the within-group estimator when estimating the different specifications as described in Equation 3.1. A log transformation of continuous variables allows to interpret estimated parameters in terms of elasticities.

The results are displayed in Table 3.4, where the Huber–White sandwich estimator is used to calculate robust standard errors. According to the estimated coefficients, a positive unexpected exogenous (unearned) shock in wealth may have the following impact on household structure decisions:

- *Getting married*: No significant effect is found. It seems that the number of marriages in a province is not affected by random wealth shocks (as proxied here). Maybe this decision is conditioned by reasons other than monetary ones. Nevertheless, male unemployment rate negatively affects marriage decisions. Specifically, one-percentage-point increase in male unemployment rate reduces marriages 0.011 per cent. This result is in line with the ones found in González-

Val and Marcén (2018). At the same time, female unemployment seems to affect in a positive way this decision, although at a smaller level of significance.

Table 3.4. Panel data estimates (fixed-effect model)

Dependent variable (log of the number of …)

	Marriages	Divorces and separations	Births
Random wealth shock			
only-winning province (t-1)	0.018 (0.026)	0.026** (0.013)	0.025 (0.016)
only-winning province (t-2)	0.022 (0.025)	0.042*** (0.015)	0.028*** (0.028)
Macroeconomic variables			
GDP (log)	0.103 (0.185)	0.368*** (0.108)	0.481*** (0.134)
Population (log)	0.904*** (0.232)	0.052 (0.122)	0.332 (0.201)
Foreign population (rate)	-0.896* (0.503)	0.232 (0.320)	1.618*** (0.304)
Higher education (rate)	0.042 (0.222)	-0.235 (0.224)	-0.142 (0.170)
Male unemployment (rate)	-0.011*** (0.002)	-0.001 (0.002)	-0.004*** (0.001)
Female unemployment (rate)	0.004* (0.002)	0.003* (0.001)	0.001 (0.001)
Year dummies	YES	YES	YES
Constant	YES	YES	YES
R^2 within	0.803	0.644	0.824
Provinces	52	52	52
Number of observations	832	831[a]	832

Notes: Robust standard errors are reported in parentheses. Correlation coefficient between *only-winning province* (t-1) and *only-winning province* (t-2) is -0.009, which is not statistically significant from zero (p-value=0.800). [a] Information for *Ceuta* in the year 2015 is not available. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

- *Getting divorced*: A positive impact of a shock of wealth on the number of divorces in a province is observed – i.e. there are 2.6 percent more divorces the year after the lottery winning. However, the strongest significant effect is produced more than a year after the Christmas lottery draw – previous figure raises to 4.2 percent two years after. It must be considered that the process of separation and/or divorce is not an immediate one even when the decision has been made (in Spain, it takes 4–6 months on average). Following Becker's theoretical framework on human decisions about marriage and divorce (1973, 1974) and, particularly, Becker et al.'s (1977) study, which analyzed the causes of marital stability, many contributions to this field producing opposite results have been published in the literature. In general, it has been suggested that an income or wealth shock (positive or negative) affects the probability of getting divorced subject to a sufficiently flexible division of wealth between spouses.

Thus, Nock (2001) and Sayer and Bianchi (2000) found a positive relationship between wives' income and divorce as it provides a chance to exit a "bad marriage." On the other hand, Charles and Stephens (2004) and Nunley and Seals (2010), among others, found that negative (positive) transitory household income shocks increase (decrease) the probability of getting divorced. From the financial perspective of lottery winners, the result here could be explained by the fact that the greater the mismatch between a couple's credit scores, the more likely they are to separate within the first five years, according to Dokko et al. (2015).

- *Having children*: Winning the Christmas lottery jackpot in year *t-2* is linked to a significant positive but modest-sized increase in the number of births in the winning province (around 3 percent). This may make sense since there is a nine-month period until a child is born. Furthermore, for a woman, becoming pregnant is not an action that is immediately effective. Based on the seminal work by Ghez and Becker (1975), a number of contributions have proved the potential relationship between the economic environment (sometimes determined by unexpected wealth shocks) and people's decision to have children (Amialchuk 2006; Black et al. 2013; Lindo 2010; Lovenheim and Mumford 2013). This result could also be explained by families anticipating the decision to have children when receiving the wealth shock (lottery prize) or when the exogenous surrounding economic conditions change. Macroeconomic controls seems to be in line with Bellido and Marcén, 2019, as it is found a procyclical behavior.

Macroeconomic variables (controls)

Although this chapter aims to assess the effects of exogenous wealth shocks (winning the jackpot of the Spanish Christmas lottery) on household decisions, a discussion on the results of the control variables included in all the model specifications in Table 3.4 is also provided.

Overall, the results show a positive and significant effect for the income variable, except for the specification for the number of marriages. Surprisingly, the decision to get married seems not to be conditioned by provincial income. However, it appears that divorces tend to increase, rather than decrease, with provincial income. Regarding births, their number is positively conditioned by the economic environment.

With respect to the population variable, an expected positive effect is obtained for the number of marriages. The larger the market, the greater the number of relationships. It seems obvious that people's social networks increase in size as the population grows. In terms of the population's social structure, the greater the foreign population rate in a province, the higher the number of births observed in that province. This is consistent with the findings of Tromans et al. (2009), who examined the demographic drivers

underlying the number of births in the UK and concluded that two-thirds of the rise in births since 2001 can be attributed to foreign-born women. As for education, no significant effect of the higher-education rate in a province is found.

The labor situation in the province clearly affects household structure decisions but in a different way according to gender. In all cases, other than getting divorced, a negative impact of male unemployment on the outcome variable is estimated. This is in line with previous literature that found the unemployment of the husband to have a negative effect on marriage and family relationships (Larson 1984). On the other hand, female unemployment seems to affect the number of both marriages and divorces weakly and positively (significant at the 10 percent level). In general, household decision making seems to be affected more by men's unemployment than by women's unemployment.

Excluding Lleida and Madrid from the analysis

In the 2004 draw, all *El Gordo* lottery tickets that won the jackpot were sold in the town of Sort (*Lleida*), in just a single outlet (*La Bruixa d'Or*). The total amount of the prize, which reached 390 million euros, was spread over various regions (more than half of the tickets were sold online and the rest were distributed to lottery players in *Mallorca*, *Madrid* and *Jaen*). Actually, that lottery outlet in *Sort* is famous for selling the winning tickets of the Christmas lottery jackpot on three occasions in 2003, 2004 and 2007. As for *Madrid*, the lottery outlet known as *Doña Manolita* is the one that gives out the greatest number of lottery prizes in Spain. Each Christmas, there are requests from people from different provinces who want to buy lottery tickets there. The provinces of *Lleida* and *Madrid* may be then treated as outliers and so excluded from the estimation sample.

As the estimates from Table 3.5 show, very similar coefficient estimates for the variables representing household structure decision are obtained when excluding Lleida and Madrid from the sample. The most notable exception is that no significant effect on the number of divorces and separations is found for the immediate year after the lottery winning.

Another recent phenomenon to be considered here is the increasing possibility of buying Christmas lottery tickets through the Internet. However, as discussed by Bagues and Esteve-Volart (2016), only around 2 percent of all tickets are purchased online.

Table 3.5. Panel data estimates (fixed-effect model)

Dependent variable (log of the number of …)

	Marriages	Divorces and separations	Births
Random wealth shock			
only-winning province (t-1)	0.026 (0.043)	0.021 (0.019)	0.030 (0.018)
only-winning province (t-2)	0.010 (0.035)	0.060*** (0.013)	0.038*** (0.006)
Macroeconomic variables			
GDP (log)	0.116 (0.188)	0.353*** (0.110)	0.509*** (0.135)
Population (log)	0.901*** (0.238)	0.067 (0.123)	0.326 (0.200)
Foreign population (rate)	-0.929* (0.551)	0.167 (0.339)	1.678*** (0.339)
Higher education (rate)	0.047 (0.240)	-0.224 (0.231)	-0.124 (0.173)
Male unemployment (rate)	-0.011*** (0.002)	-0.001 (0.002)	-0.005*** (0.001)
Female unemployment (rate)	0.004* (0.004)	0.002* (0.001)	0.001 (0.001)
Year dummies	YES	YES	YES
Constant	YES	YES	YES
R^2 within	0.802	0.640	0.824
Provinces[a]	50	50	50
Number of observations	800	799[b]	800

Notes: Robust standard errors are reported in parentheses. [a] *Lleida* and *Madrid* are not included. [b] Information for *Ceuta* in the year 2015 is not available. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

A more informative model specification

To provide a more informative specification and to test the robustness of the results, the indicators of *only-winning provinces* in Equation 3.1 are replaced with the ratio of the effectively collected jackpot share for each province to the corresponding province's GDP (following Bagues and Esteve-Volart 2016), so all the provinces that have obtained at least a portion of *El Gordo* are now considered. Two lags of this variable and their squared terms to control for non-linear effects are included in the specification. The same controls are maintained as in the previously discussed estimates.

The estimates in Table 3.6 are in line with those in Table 3.4. A positive effect of the jackpot share received by a certain winning province on the number of divorces in that province is noted, even for the first lag. With regard to having children, a similar positive

effect on the number of births is observed for both the linear and the quadratic term of the second lag of the lottery prize variable. In both cases, according to the shape of the estimated relationship, a positive and increasing marginal return is found. No effect on the number of marriages continues to be apparent. These results seem to corroborate the previous findings – again, nothing relevant changes when excluding the provinces of *Lleida* and *Madrid* from the analysis.

Table 3.6. A more informative specification—Panel data estimates (fixed-effect model)

	Dependent variable (log of the number of …)		
	Marriages	Divorces and separations	Births
Random wealth shock			
$(Jackpot/GDP)_{t-1}$ (log)	-0.004 (0.007)	0.016** (0.007)	0.005 (0.005)
$(Jackpot/GDP)_{t-1}^2$ (log)	-0.1×10^{-3} (0.000)	0.5×10^{-3}** (0.000)	0.2×10^{-3} (0.000)
$(Jackpot/GDP)_{t-2}$ (log)	-0.003 (0.008)	0.021*** (0.004)	0.008*** (0.003)
$(Jackpot/GDP)_{t-2}^2$ (log)	-0.8×10^{-4} (0.000)	0.7×10^{-3}*** (0.000)	0.3×10^{-3}*** (0.000)
Macroeconomic variables			
GDP (log)	0.107 (0.183)	0.356*** (0.108)	0.476*** (0.134)
Population (log)	0.904*** (0.231)	0.050 (0.121)	0.334 (0.200)
Foreign population (rate)	-0.914* (0.502)	0.274 (0.318)	1.630*** (0.304)
Higher education (rate)	0.048 (0.222)	-0.196 (0.224)	-0.133 (0.171)
Male unemployment (rate)	-0.011*** (0.002)	-0.001 (0.002)	-0.004*** (0.001)
Female unemployment (rate)	0.004* (0.002)	0.003* (0.001)	0.001 (0.000)
Year dummies	YES	YES	YES
Constant	YES	YES	YES
R^2 within	0.803	0.643	0.826
Provinces	52	52	52
Number of observations	832	831[a]	832

Notes: Robust standard errors are reported in parentheses. [a] Information for *Ceuta* in the year 2015 is not available. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Limitations and further considerations

The empirical analysis presented here carries some limitations. First, although the data used in this chapter eliminate the bias induced by self-reporting in surveys of lottery winners (commonly used in previous studies), the main disadvantage is collapsing individual-level data to the aggregate level of a province. This means that no strong conclusions can be drawn about individual behavior – in fact, individuals' risk aversion is likely to correlate with both household structure decisions and the probability to win the lottery. Second, since the three considered variables regarding household structure decisions may have similar underlying determinants, a seemingly unrelated regression (SUR) model (Zellner 1962) could be considered as an alternative. However, the coefficient estimates are similar to those from the within-group estimator, the correlation between the errors in the three equations is not particularly strong, and the efficiency gains of an SUR model compared with the fixed-effect model are relatively modest (the SUR estimates are available on request). Finally, even though economists have traditionally considered household as a single unit that maximizes a common objective function, some evidence suggests that household is a collective, not a unitary, entity and that choices depends in part on who controls the household income (Duflo 2003). This issue is not addressed here and may deserve special attention in future research.

Concluding remarks

The decisions of households in developed countries are much more complex today than in past decades. For this reason, the analysis of household decision making and behavior and the study of the variables that condition their decisions have attracted reasonable interest in recent years. This paper proposes an innovative empirical exercise that would make it possible to estimate the effect of a significant positive variation in household wealth and/or the surrounding economic conditions on decisions that extend beyond mere consumption expenditure and that could affect the structure of the household.

A number of previous studies have examined the importance of exogenous (unearned) random wealth shocks on a number of household decisions using lottery winnings as a proxy for such variations in wealth or in environmental economic conditions. In this chapter, the Christmas draw of the Spanish National Lottery is used as a natural experiment to explore the effect on household structure decisions.

The focus is on exploring whether the fact that the Christmas draw's winning tickets are sold in a particular province affects the number of marriages or divorces and the number of births in that province. The aggregate size of such an exogenous random shock is equivalent to 5.28 percent of the median GPD of Spanish provinces in 2017—that is, around 700 million euros. Up to 1,720 individuals in a unique winning province are expected to collect at least 400,000 euros each. In addition, winning the lottery may

generate exogenous good economic conditions in the area (province) and so affect people's overall happiness and decision making.

The results from a panel data fixed-effect regression indicate that a positive unexpected exogenous (unearned) wealth shock is linked to an increase in the number of births as well as in the number of divorces in a province. However, no significant result is found regarding the number of marriages. Nevertheless, the importance of the unexpected impact seems to be conditioned by the amount of the effectively collected prize. All in all, the evidence is consistent with couples getting divorced and having children when their province's economic conditions change due to an unexpected increase in wealth.

From the perspective of policy implications, since a better financial situation makes husband and wives finish their probably bad marriages, improving their quality of life and probably avoiding domestic violence. Indeed, results on fertility rate are also important from a policy perspective due to the current demographic scenario in Spain and the rest of Europe. Beyond that, it is also important to remove the barriers that prevent society from having the desired offspring in order to improve life quality. These results could give guidance to policymakers to increase their accuracy when identifying the regions in which to implement social policies. Anyway, the statistical data on household structure decision making are relevant for population research purposes.

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CONCLUSIONS

This thesis studies the public impact of lottery products by analyzing lottery consumption patterns by country and world region and the effects these have on the way prizes are distributed. In addition, in an experimental analysis where the first prize of the Christmas Draw of National Spanish Lottery is used as a natural experiment to try to find out how Spanish families react to a positive wealth shock. It is made up of three chapters of an empirical nature that are supported by three different and independent databases that have been created exclusively for this doctoral thesis.

The first chapter addresses both at a global and regional level two key parts of the impact of lotteries on society: regressivity and the distribution of funds to social interests, such as culture, education or sports. With a database that collects sales data of 60 operators in countries on five continents, complemented in turn with data on income from the World Bank, the results indicate that those operators that allocate part of the budget to education or social activities see their sales increase, not finding significant effects for the other types of contributions. Regarding the regressivity of lottery products, the results indicate that lotteries are normal goods in all world regions, although high heterogeneity is found at geographical level. The elasticities found are always below the unit, which means that, from the point of view of Public Economics, lotteries can be categorized as regressive products.

Several policy implications can be drawn from this chapter: Using this chapter as evidence on which social purposes are most valued by lottery consumers, lottery operators can increase their sales by also increasing their contributions to this type of social purpose. In this case, the regressive nature of the lotteries would mean that a greater part of the collection would fall on those with lower incomes., increasing income inequality. In this context, it is necessary to analyze which social stratum obtains the greatest benefit from the increase in spending on social purposes, since it is possible that the lower economic classes do not receive the services subsidized by the operators as the higher classes do.

The second chapter studies the demand for a recently created pari-mutuel and multi-state lottery game such as EuroMillions, as well as its effects on the distribution of the first prize of this draw. This chapter highlights the heterogeneity of the demand for EuroMillions and the effect that the jackpot has on it, as well as the direct consequences of the variations in participation in the draw by country, specifically in the distribution of the jackpot.

In particular, this chapter shows a great heterogeneity in the demand for EuroMillions between countries where the accumulated jackpot acts as the main factor causing changes in the composition of demand, although the income elasticity is always below one. These variations in demand affect country's chances of winning the prize. Because of this, the biggest prizes tend to go to entrants from more jackpot-sensitive countries. This is a novel

exercise, since no other exercise is known to date that evidences the implicit transfers of funds among countries in the distribution of prizes.

As recommendations to the operators of this product, it is proposed to expand the media coverage of the prizes in countries with lowest payout rates. As well as the possibility of transferring part of the funds to mentioned countries through the creation of a particular mechanism. It should be noted that, to be able to reach a certain degree of generality and extend these conclusions to other multi-state lottery draws, such as Powerball and MegaMillions in the United States, a case study adapted to these products, such as the one carried out, is recommended as an extension. in this document for EuroMillions.

Finally, the third chapter analyzes how a positive and random wealth shock, such as the first prize in the Christmas Draw of National Spanish Lottery, can affect families' decisions. Using a database with a panel structure that contains all the Spanish provinces and their autonomous cities for the period between 2000 and 2018 and treated with a difference-in-differences methodology, this last chapter shows that a shock of this type positively affects the birth rate of the provinces awarded in the two years following the draw, also contributing positively to the increase in separations and divorces within the province, also in the two years following the holding of the draw. However, the results of the regressions on nuptiality lack significance, so no statement can be made in this regard.

This chapter, in addition to providing evidence on the behavior pattern of families in the face of wealth shocks, joins the previous empirical contributions that use this type of draws and prizes as a natural experiment, making even more relevant this causal identification strategy that has made economic science advance so much in recent years.

This evidence on the effects of this positive and random shock of wealth on the birth rate and on the end of marriages may be important when designing sociodemographic public policies. In the current demographic context, it is important to determine what factors encourage a higher birth rate and, in addition, it is also important to eliminate the barriers that prevent society from having the desired offspring. In relation to the end of marriages, these increases in wealth facilitate the decision of divorce or separation in low-quality relationships, in which acts of domestic violence are more likely.

It is true that this doctoral thesis is based on three databases that contain aggregated data and, as has been pointed out in previous chapters, the use of aggregated data in empirical studies has a series of advantages, such as being able to determine which regions suffer a higher tax burden or in which regions a public policy is more effective, it is also important to highlight that a restrictive assumption is implicitly being made: Using aggregated data in these studies it is assumed that all the inhabitants of the geographic unit have the same preferences.

With the aim of creating precise empirical evidence and, in any case, complementary to the existing one, supported by random experiments such as the one carried out in this last chapter, it would be interesting if, maintaining the voluntary anonymity of the winners of a prize of these characteristics, the data about the place of residence at a more disaggregated level, as well as other personal data such as those related to the purchasing

power of the individual or the family unit, employment status, etc. Researchers based in our country and abroad could use this data for academic purposes in order to determine behavior patterns in our society, as well as possible effects of public policies.

Considering both the economic context and the results shown in this thesis, two future lines of research are presented. Firstly, it is necessary to provide scientific evidence on the effect of increasing the tax on lottery prizes, and more specifically on grand prizes. It is important to elucidate whether the increase in taxes on large lottery prizes represents an effective and efficient income for the public coffers and whether this practice distorts the demand for this type of product.

Secondly, it would be important, as well as interesting, to determine how demand reacts to situations of great uncertainty regarding the future income of families. From the point of view of public policy, it is important to generate evidence on the assumption of risks in situations of uncertainty since, in the event of not obtaining the predicted output, in this case a lottery prize, entire families may fall into risk of poverty and social exclusion, increasing inequality and affecting the future opportunities of the youngest members of the family unit.

CONCLUSIONES

Esta tesis doctoral estudia el impacto público de los productos de lotería mediante el análisis de patrones de consumo de loterías por países y continentes y los efectos que éstos tienen en el modo en el que se reparten los premios. Además, en un análisis experimental, el primer premio del Sorteo Extraordinario de la Lotería Nacional de Navidad en España es usado como experimento natural con el fin de averiguar cómo reaccionan las familias españolas ante un shock positivo de riqueza. Está formada por tres capítulos de naturaleza empírica que se apoyan en tres bases de datos diferentes e independientes entre sí que han sido creadas exclusivamente para esta tesis doctoral.

El primer capítulo aborda tanto a nivel mundial como regional dos partes clave del impacto de las loterías en la sociedad: la regresividad y la distribución de los fondos a intereses sociales, como pueden ser la cultura, educación o deporte. Con una base de datos que recoge los datos de venta de 60 operadores en países de cinco continentes, complementada a su vez con datos sobre renta de los países del Banco Mundial, los resultados indican que aquellos operadores que destinan parte del presupuesto a educación o actividades sociales ven aumentadas sus ventas, no encontrando efectos significativos para los demás tipos de contribuciones. En cuanto a la regresividad de los productos de lotería, los resultados indican que las loterías son bienes normales en todas las regiones mundiales, aunque se encuentra una alta heterogeneidad a nivel geográfico. Las elasticidades encontradas están situadas siempre por debajo de la unidad, lo que hace que, desde el punto de vista de la Economía Pública, las loterías pueden ser categorizadas como productos regresivos.

De este capítulo se pueden obtener varias implicaciones políticas: Usando este capítulo como evidencia sobre qué fines sociales son más valorados por los consumidores de lotería, los operadores de lotería pueden aumentar sus ventas aumentando también sus aportaciones a este tipo de fines sociales. En este caso, el carácter regresivo de las loterías haría que recayese una mayor parte de la recaudación sobre las rentas más bajas, aumentando la desigualdad de renta. En este contexto, es necesario analizar qué estrato social obtiene mayor beneficio del aumento del gasto en fines sociales, que es posible que las clases económicas bajas no disfruten de los servicios subvencionados por los operadores como lo hacen las clases más altas.

En el segundo capítulo se estudia la demanda de un juego de loterías pari-mutuel y multi-estado de reciente creación como es el EuroMillones, así como sus efectos en la distribución del primer premio de este sorteo. Este capítulo evidencia la heterogeneidad de la demanda de EuroMillones y el efecto que el bote acumulado tiene sobre ella, así como las consecuencias directas de las variaciones en la participación en el sorteo por países, concretamente en la distribución del bote.

En particular, este capítulo evidencia una gran heterogeneidad de la demanda de EuroMillones entre países donde el bote acumulado actúa como principal factor, provocando cambios en la composición de la demanda, aunque la elasticidad renta se sitúa siempre por debajo de la unidad. Estas variaciones en la demanda afectan a las probabilidades de un país de ganar el premio. Debido a esto, los premios más grandes tienden a recaer sobre participantes de países más sensibles al bote acumulado. Se trata de un ejercicio novedoso, ya que no se conoce otro hasta la fecha que evidencie las transferencias implícitas de fondos entre países en la distribución de los premios.

Como recomendaciones hacia los operadores de este producto, se propone ampliar la cobertura mediática de los premios en países con tasas de retorno en los premios menores. Así como se plantea la posibilidad de transferir parte de los fondos a dichos países mediante la creación de un mecanismo particular. Cabe destacar que, al objeto de poder alcanzar un cierto grado de generalidad y extender estas conclusiones a otros sorteos de lotería multi estado como puede ser en Estados Unidos Powerball y MegaMillions, se recomienda como extensión un estudio de caso adaptado a estos productos como el realizado en el presente documento para EuroMillones.

Por último, el tercer capítulo analiza cómo un shock positivo y aleatorio de riqueza, como es el primer premio del Sorteo Extraordinario de Navidad de la Lotería Nacional, puede afectar a las decisiones de las familias. Usando una base de datos con estructura de panel que contiene todas las provincias españolas y sus ciudades autónomas para el periodo comprendido entre el año 2000 y el 2018 y tratada con una metodología de diferencia en diferencias, este último capítulo evidencia que un shock de este tipo afecta positivamente a la natalidad de las provincias agraciadas en los dos años siguientes al sorteo, contribuyendo también positivamente al aumento de las separaciones y divorcios dentro de la provincia, también en los dos siguientes años a la celebración del sorteo. Sin embargo, los resultados de las estimaciones sobre nupcialidad carecen de significatividad, por lo que no se pueden realizar afirmaciones al respecto.

Este capítulo, además de proporcionar evidencia sobre el patrón de comportamiento de las familias ante shocks de riqueza, se une a las previas contribuciones empíricas que utilizan este tipo de sorteos y premios como experimento natural, haciendo todavía más relevante esta estrategia de identificación causal que tanto han hecho avanzar a la ciencia económica en los últimos años.

Esta evidencia sobre los efectos de este shock positivo y aleatorio de riqueza sobre natalidad y también sobre la finalización de matrimonios puede ser importante a la hora de diseñar políticas públicas de índole sociodemográfica. En el contexto demográfico actual es importante determinar qué factores incentivan una mayor natalidad y, además, es también importante eliminar las barreras que impiden a la sociedad tener la descendencia deseada. En relación con la finalización de matrimonios, estos aumentos en la riqueza facilitan la decisión de divorcio o separación en relaciones de baja calidad, en los que los actos de malos tratos son más probables.

Es cierto que esta tesis doctoral se apoya en tres bases de datos que contienen datos agregados y que, como se ha señalado en capítulos anteriores, el uso de datos agregados en estudios empíricos tiene una serie de ventajas como la de poder determinar qué regiones sufren una mayor carga impositiva o en cuáles es más efectiva una política pública, es también importante resaltar que implícitamente se está realizando un supuesto un tanto restrictivo: Usando datos agregados en estos estudios se asume que todos los habitantes de la unidad geográfica tienen las mismas preferencias.

Con el objetivo de crear evidencia empírica precisa y, en todo caso, complementaria a la actual, apoyada en experimentos aleatorios como el que se lleva a cabo en este último capítulo, sería interesante que, manteniendo el anonimato voluntario de los agraciados con un premio de estas características, se hicieran públicos los datos acerca del lugar de residencia a un nivel más desagregado, así como otros datos personales como pueden ser los relativos al poder adquisitivo del individuo o la unidad familiar, situación laboral, etc. Investigadores basados en nuestro país y también en el extranjero podrían utilizar estos datos con fines académicos para poder determinar patrones de comportamiento de nuestra sociedad, así como posibles efectos de políticas públicas.

Teniendo en cuenta tanto el contexto económico como los resultados mostrados en esta tesis, se presentan dos futuras líneas de investigación. En primer lugar, es necesario aportar evidencia científica sobre el efecto de aumentar el gravamen sobre los premios de lotería, y más concretamente sobre los grandes premios. Es importante dilucidar si el aumento de los impuestos a los grandes premios de lotería supone un ingreso efectivo y eficiente para las arcas públicas y si esta práctica distorsiona la demanda de este tipo de productos.

En segundo lugar, resultaría importante, a la par que interesante, determinar cómo reacciona la demanda a situaciones de gran incertidumbre sobre la renta futura de las familias. Desde el punto de vista de las políticas públicas, es importante generar evidencia sobre la asunción de riesgos ante situaciones de incertidumbre ya que, en caso de no obtener el output pronosticado, en este caso un premio de lotería, familias enteras pueden caer en riesgo de pobreza y exclusión social, aumentando la desigualdad y afectando a las oportunidades futuras de los integrantes más jóvenes de la unidad familiar.