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Financial markets diffusion patterns. The case of Mexican investment funds

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Abstract
Research background: Exchange traded funds (ETFs) are one of the most influential financial innovations, reshaping the investment funds market in many countries, including Mexico. Due to their similar investment objectives, ETFs are considered substitutes for mutual funds.
Purpose of the article: The aim of the article is to provide an in-depth insight into the issues associated with the development of financial markets in Mexico over the period 2002 –2012, putting special emphasis on the development patterns of ETFs.
Methods: First we use descriptive statistics to unveil basic changes and trends in the Mexican investment funds (ETFs and mutual funds). Then we use a category of the innovation diffusion models, i.e. logistic growth models, in order to explore the key development patterns. Data sources and methodological framework are presented in the second section of the article, with a detailed description of the innovation diffusion models applied in the research

(based on 3-parametric logistic curve). The sum of assets under management of ETFs and mutual funds is considered as the size of the total investment funds market.
Findings & Value added: Empirical findings indicate a significant development of the ETF market, both in terms of assets under management and market share. According to the presented estimations, Mexican ETF market development can be described with the logistic growth models, and three characteristic phases of the logistic curve were clearly observable. The predicted ETF market development patterns point towards a further increase of the market share of ETFs over the next 3-5 years, yet the probability of exceeding the level of ca. 20-30% seems low.

Introduction

This paper is designed to provide an in-depth insight into the issues associated with the development of financial markets in Mexico over the period of 2002–2012, putting special emphasis on the development patterns of Exchange Traded Funds (hereafter — ETFs). To this aim, first we used descriptive statistics to unveil basic changes and trends in ETF market development between 2002 and 2012; and second we deployed the methodological framework encompassing innovation diffusion models, which allowed for a detailed analysis of ETF market development patterns, examining the dynamics of the process and predicting its future changes.

This paper comprises four logically structured sections. The first section presents the conceptual background explaining the issues associated with ETFs and other categories of investment funds. The second section presents data sources, as well as an outline of methodological settings. Section three is divided into two parts: demonstration of preliminary evidence on ETF market development is followed by a discussion on major empirical results. Finally, the paper concludes with main findings.

Our study concentrates on Mexico, which is relatively rarely exemplified as an emerging economy with developed investment funds market that consists of not only well-established, traditional mutual funds, but also of innovative ones, i.e. ETFs. Mexico should be thus regarded as a benchmark country in establishing the path of ETFs diffusion that may be followed by other emerging economies once they introduce ETFs to their financial markets. Mexican ETF market is one of the largest among emerging countries as evidenced by its size — in 2012 assets of ETFs listed in Mexico exceeded 8.7 bln USD compared with only ca. 2 bln USD in the whole Middle East and Africa region or ca. 2.5 bln USD in India; the only emerging country with a larger ETF market in 2012 was China (BlackRock, 2012).

Investment funds: selected categories

In this article, we focus on two types of financial companies: Exchange Traded Funds (ETFs) and mutual funds. We label these two groups together as 'investment funds'. Mexican investment funds market is thus a market consisting of ETFs and mutual funds available primarily in Mexico. ETFs may be regarded as a case of financial innovations comparing to mutual funds that are a rather traditional investment option. In order to fully understand the changes observed on the investment funds market, the main features of ETFs and mutual funds will be discussed as well as their differences.

Mutual funds are financial companies, dating back to the 1920s. They are defined as investment companies that buy a portfolio of securities selected by the fund's manager and manage them in order to meet a specified investment objective; mutual funds are ready to buy back their shares at their current value, calculated by the company itself (ICI, 2015, p. 277). One type of mutual funds, particularly important in the context of this research, are index (mutual) funds, i.e. mutual funds designed to track the performance of a selected market index (tracking is understood as trying to replicate the rate of return of selected assets).

The history of ETFs is relatively shorter, as first such funds were launched on the North American stock exchanges in the early 1990s (Deville, 2006, pp. 4–6). Despite the growing diversity of the ETFs category, most of them are still funds whose units are traded on stock exchanges, where they can be bought or sold by various groups of investors (analogically to stocks of listed companies) (International Monetary Fund, 2011, p. 68). Prices of units of ETFs track the performance of chosen assets, mostly equity or fixed income market indexes; however, in recent years new types of ETFs were launched, including, among others, commodity ETFs and ETFs offering magnified and/or inverse returns (leveraged, inverse and leveraged-inverse ETFs) (Financial Stability Board, 2011, pp. 3–5).

Due to similar investment aims and group of users, ETFs should be considered as substitutes for mutual funds, especially their subcategory i.e. index funds. ETFs offer a number of innovative features, unavailable in the conventional funds, which led to their big and growing popularity. The key difference between ETFs and index funds is the course of the redemption process, understood here as the way to exit the investment. In the case of ETFs it is possible through the stock exchange, while in case of index funds shares need to be bought back by the managing company. Moreover, valuation of the fund's units is also conducted differently. The prices of ETFs depend on the demand and supply, together with the arbitrage transactions

undertaken by the market participants, especially the ones involved in the creation of ETFs' units (as a result of arbitrage transactions market values of ETFs' units and tracked assets remain close; for more details see e.g. (Ramaswamy, 2011, pp. 1–4)). Managing companies (or appointed institutions) calculate the value of mutual funds' units, usually once a day — it is the value used to process the transactions.

The most important differences between ETFs and index funds are summarized in Table 1 (the table presents a comparison of ETFs and one type of mutual funds but it may be related to the whole category of mutual funds). Lower costs of investments in ETFs than in conventional mutual funds result from different distribution method and lower number of intermediaries involved in the distribution of the funds' units — costs are mostly limited to the stock exchange's brokerage fees. Tracking errors are discrepancies between the return on a given fund and the tracked index (or other assets; such errors should be minimized). ETFs are more efficient than index funds in this aspect as a consequence of the arbitrage transactions conducted on the stock exchanges — such transactions can be undertaken during the trading hours and large deviations will be removed, while in case of index funds they may prevail. Tracking costs and errors are especially low for relatively recent types of ETFs such as synthetic ETFs, whose tracking mechanism is based on derivatives (Kosev & Williams, 2011, pp. 54–55). Synthetic replication is used most often in European ETFs.

Apart from the benefits listed in Table 1, ETFs give their users access to a number of other benefits in comparison to mutual funds: higher liquidity, opportunity to invest easily and at low cost in foreign assets (through ETFs tracking e.g. foreign stocks, yet listed on a domestic exchange), and higher tax efficiency (in some countries) (for full discussion see Lechman & Marszk, 2015). Relative disadvantages are linked above all with more sophisticated types of ETFs (such as synthetic funds): impeded risk evaluation or (very limited) counterpart risk (IMF, 2011, pp. 69–72).

Research method

To achieve our major empirical goals we use data on Exchange Traded Funds and mutual funds in Mexico between the years 2002 and 2012: in 2002 first ETF was launched in Mexico and 2012 is the last year with acquirable full dataset on ETFs. The key indicator applied for the analysis is assets under management (AUM) of various types of investment funds, i.e. assets managed within selected funds. The data on the assets of mutual

funds was extracted from the Investment Company Fact Book published by the Investment Company Institute (Investment Company Institute, 2008, 2013). Due to lack of such database regarding ETFs in Mexico, the Authors' estimates of assets of ETFs were used. Estimates were derived from Latin American regional statistics published by BlackRock Investment Institute, calculations involved subtracting assets of the second largest regional ETF market — in Brazil (using information from reports published by the ETF providers, i.e. managing companies; assets of ETFs listed in other Latin America countries are close to 0) (BlackRock, 2011, 2012). Only ETFs for which Mexico is the primary listing location were taken into consideration (in order to prevent double counting and due to lack of reliable data on the actual share of assets of cross-listed ETFs acquired in a given country).

In this article, the development of the Mexican ETF market is understood twofold as: absolute growth in the value of assets of ETFs in Mexico (measured using absolute values of their AUM); and — growth in share of ETFs in the total value of Mexican investment funds' assets (sum of assets of ETFs and mutual funds).

To reach the main aims of the study, we adopt the methodological framework allowing for identification of the time evolution of the processes reported across examined financial markets regarding, *inter alia*, ETFs diffusion. Therefore, we use innovation diffusion models (Geroski, 2000; Rogers, 2010; Kwasnicki, 2013; Lechman, 2015), which are applied for approximations of ETFs diffusion trajectories and exhibit projected future ETFs development patterns. Analogous approach to the identification of the ETF market evolution is reported in the study of Lechman and Marszk (2015), who analyze the ETFs diffusion paths in selected emerging markets. To display the ETF market development patterns we use the empirical framework of innovation diffusion model provided in the influential works of, *inter alia*, Mansfield (1961) and Dosi and Nelson (1994), who analyzed the phenomenon adopting the evolutionary dynamics concept. The concept may be mathematically expressed as the logistic growth function, that if written as an ordinary differential equation is as follows (Meyer *et al.*, 1999):

$$\frac{dY_x(t)}{dt} = \alpha\, Y_x(t)\,. \tag{1}$$

If $Y(t)$ denotes the level of variable x, (t) is time, and α is a constant growth rate, then Eq. (1) explains the time path of $Y(t)$. If we introduce e[1] to Eq. (1), it can be reformulated as:

$$Y_x(t) = \beta e^{\alpha t}, \tag{2}$$

or alternatively:

$$Y_x(t) = \alpha \exp \beta t, \tag{3}$$

with notation analogous to Eq. (1) and β representing the initial value of x at $t = 0$. The simple growth model is pre-defined as exponential; thus, if left to itself x will grow infinitely in geometric progression. Indiscriminate extrapolation of $Y_x(t)$ generated by an exponential growth model may lead to unrealistic predictions, as due to various constraints, systems do not grow infinitely (Meyer, 1994). Therefore, to solve the problem of 'infinite growth', the 'resistance' parameter (Kwasnicki, 2013) was added to Eq. (1). This modification introduces an upper 'limit' to the exponential growth model, which instead gives the original exponential growth curve a sigmoid shape. Formally, the modified version of Eq. (1) is the logistic differential function, defined as:

$$\frac{dY_x(t)}{dt} = \alpha Y_x(t)\left(1 - \frac{Y_x(t)}{\kappa}\right), \tag{4}$$

where the parameter κ denotes the imposed upper asymptote that arbitrarily limits the growth of Y_x.

As already mentioned, adding the slowing-down parameter to exponential growth generates an S-shaped trajectory (see Figure 1). The 3-parameter logistic differential equation, Eq. (4), can be re-written as a logistic growth function, taking non-negative values throughout its path:

$$N_x(t) = \frac{\kappa}{1 + e^{-\alpha(t-\beta)}}, \tag{5}$$

where $N_x(t)$ stands for the value of variable x in time period t. The parameters in Eq. (5) explain the following: κ - upper asymptote, which determines the limit of growth also labeled 'carrying capacity' or 'saturation'; α — growth rate, which determines the speed of diffusion; β — midpoint, which determines the exact time (T_m) when the logistic pattern reaches

[1] Base of natural logarithms.

0.5κ. However, to facilitate interpretation, it is useful to replace α with a 'specific duration' parameter, defined as $\Delta t = \frac{\ln(81)}{\alpha}$. Having Δt, it is easy to approximate the time needed for x to grow from 10%κ to 90%κ. The midpoint (β) describes the point in time at which the logistic growth starts to level off. Mathematically, the midpoint stands for the inflection point of the logistic curve. Incorporating Δt and (T_m) into Eq. (5), entails:

$$N_x(t) = \frac{\kappa}{1+exp\left[-\frac{\ln(81)}{\Delta t}(t-T_m)\right]}. \tag{6}$$

In our research, we aim to use the methodological framework regarding innovation diffusion model, which has been briefly presented above. To complete the analysis, we assume that the process of growing ETFs' share in total assets of investment funds may be claimed as analogous to the process of diffusion of innovations across heterogeneous socio-economic systems. Henceforth, we claim that ETFs are innovations, which due to 'word of mouth' effect (Geroski, 2000) and emerging network effects, are gradually adopted by increasing number of investors (users). We also rely on the basic assumption that investors (users) of financial innovations (in here — ETFs) may freely contact and, thus it leads to broader adoption of financial innovations by 'non-investors' ('non-users'), i.e. people either not using ETFs before or choosing other similar options. The process of growing adoption of financial innovations (ETFs) is effectively enhanced by unbounded access to information ensured by broad adoption of information and communications technologies.

In short, we assume that ETFs diffuse on financial markets, gaining growing share in total assets of investment funds (apart from ETFs — mutual funds (Gastineau, 2010)). Considering the basic version of 3-parameter logistic growth model as defined in Eq. (5), we presume that $N_x(t) = ETF_i(t)$ and $ETF_i(t)$ demonstrates changes of ETFs share in assets of investment funds over time (t) in i-country. To put it differently, it shows changes of i-country`s financial market saturation with Exchange Traded Funds. The parameter κ is represented as κ_i^{ETF}, which shows the ceiling (upper asymptote/system limit) regarding the process of ETFs diffusion on financial markets. The estimated κ_i^{ETF} denotes the potential share of ETFs in total assets of investment funds on analyzed financial market in i-country, however — under rigid assumption that ETFs diffusion (development) trajectory follows sigmoid pattern generated by logistic growth equation. Next, the parameter α (as in Eq. (6)) is represented as α_i^{ETF}, which shows the speed of ETFs diffusion on analyzed financial market in

i-country. Hence, the estimated parameter α_i^{ETF} presents how fast ETFs share in total assets of investment funds is increasing over analyzed selected financial market. Moreover, using parameter α_i^{ETF}, we calculate 'specific duration' defined as $\Delta t = \frac{\ln(81)}{\alpha_i^{ETF}}$, which explains the time needed to pass from $\kappa_i^{ETF} = 10\%$ to $\kappa_i^{ETF} = 90\%$.

The β parameter is expressed as β_i^{ETF}, and its estimated value demonstrates the midpoint — $T_{m_i}^{ETF}$ indicating the exact time when 50% of κ_i^{ETF} is reached. Hence, the $T_{m_i}^{ETF}$ shows the time (year/month), when the process of ETFs diffusion is half-way, if we assume that it heads toward κ_i^{ETF}. Henceforth, the modified specification of Eq. (5) is as:

$$ETF_i(t) = \frac{\kappa_i^{ETF}}{1+exp\,(-\alpha_i^{ETF}(t-\beta_i^{ETF}))}, \tag{7}$$

with notations as explained above.

The parameters in Eq. (7) can be estimated by the use of ordinary least squares (OLS), maximum likelihood (MLE), algebraic estimation (AE), or nonlinear least squares (NLS). However, as suggested by Satoh (2001), NLS returns the relatively best predictions, as the estimates of standard errors (of $\kappa_i^{ETF}, \alpha_i^{ETF}, \beta_i^{ETF}$) are more valid than those returned from estimation using other methods. Adoption of NLS allows for avoiding time-interval biases, which are revealed in the case of OLS estimates (Srinivasan *et al.*, 1986). However, the main disadvantage of the NLS procedure is that estimates of the parameters may be sensitive to the initial values in the time-series adopted.

Exchange traded funds diffusion patterns. Empirical evidence for Mexico

This section demonstrates empirical evidence regarding ETF market development and diffusion patterns in Mexico, over the period 2002–2012.

Table 2 summarizes the key descriptive statistics of the Mexican investment funds market over the period 2002–2012, divided into two categories: ETFs and mutual funds. In 2002 assets of ETFs listed in Mexico were 110.9 mln USD, while assets of mutual funds exceeded 30 bln USD; assets of the total market reached ca. 30.9 bln USD. This shows that, in 2002, the share of ETFs in the investment funds market was minimal (at ca. 0.35%);

however, also it should be taken into account that 2002 was the year of introduction of ETFs in Mexico.

Over the next few years an impressive increase in the ETFs' assets was observed, at average annual growth rate of 39.6% (in terms of absolute AUM) or 27.2% (in terms of market share). Accordingly, the market position of mutual funds weakened (despite the growth in absolute AUM, at average rate of 11.7%), yet they are still the dominant type of investment funds, with a market share of 92.7% in 2012. The assets of ETFs were at record-high level of ca. 8.7 bln USD, assets of mutual funds were ca. 112 bln USD — size of the investment funds market slightly exceeded 120 bln USD which meant an average annual growth rate of 12.4%. Mexican ETF market was in 2012 the largest one in the Latin America region (in terms of AUM) and one of the largest among emerging economies in the world (BlackRock, 2012). More detailed discussion of the Mexican ETF market development is provided below.

In Mexico, both empirical line presenting changes in the market share of ETFs and the line showing changes in the absolute values of their AUM prove high dynamics of the ETF market development (see Figure 2 and Figure 3). Henceforth, our analysis focuses mostly on the share of ETFs in the total market as this metric is more relevant in the context of discussed possible substitution of mutual funds by ETFs.

Growth in the ETFs' market share is marked by three characteristic phases (see Figure 2). In years 2002–2005 we note relative stabilization when ETFs' market share was low. The starting point for dynamic growth of ETFs in Mexico was year 2005. In Mexico, in the period 2005–2009, the share of ETFs grew from 0.36% in 2005, to 10.31% in 2009. It is worth noting that in 2009 in Mexico, the level of ETFs' share in investment funds exceeded an analogous value in the United States, the world's most developed ETF market, which may be treated as the reference market with this respect. After reaching the peak in 2009, ETFs' market share in Mexico started to fall gradually, finally reaching in 2012 the level of 7.21%, still much higher than before the beginning of the rapid development.

Initially, the low growth rate of the ETF market in Mexico was caused by lack of diversified investment opportunities — in 2002–2005 there was only one ETF available (NAFTRAC) (BlackRock, 2011). Fast development since 2005 was spurred initially by the introduction of cross-listed ETFs (i.e. available on more than one exchange, in more than one country) tracking US stock market indices. Even though their assets were not included in the total assets of Mexican ETFs (as Mexico is not the place of their primary listing and only a fraction of their assets is actually possessed by Mexican entities) their emergence attracted attention of Mexican investors. First

such products were listed in Mexico in 2004 (by the end of that year there were 9 of them) and in 2009 their number exceeded two hundred (BlackRock, 2011). Other factors fostering the growth were the expansion of ETFs domiciled in Mexico, i.e. available solely in this country — apart from ETFs based on the equity market, products tracking fixed income indices were offered, and upswing in the Mexican stock prices (between the end of 2005 and 2009 main stock market index rose by ca. 80%) (World Federation of Exchanges, 2015). The changes occurring on the Mexican ETF market were to a large extent enhanced by more flexible regulation, encouraging ETF providers to launch such products. Moreover, the access to a wider array of investment options and competition between increasing number of ETF providers may also be regarded as two important factors influencing the development of the Mexican market. Finally, a significant role was played by growing Information and Communication Technologies (ICT) penetration rates, especially by increasing number of Internet users and the share of population having access to broadband networks. The latter enabled rapid development of the electronic trading systems, faster rate of dissemination of information and increased participation of investors as well as smoother functioning of the ETF market, limiting trading costs and tracking errors, and enabling cross-listing (for full discussion see Lechman & Marszk, 2015).

The next few years, from 2010 onward, were marked by declines (from one of the highest levels in the world) in the share of ETFs in investment funds, which was caused mainly by stagnation on the ETF market, and was accompanied by pervasive increases in the AUM of mutual funds (see Figure 2 and 3). All these resulted from a number of internal and external factors, mostly changes in the Mexican pension market (BlackRock, 2012) and withdrawal of investors caused by the outbreak of global financial crisis and increased risk aversion among financial institutions and individual investors, especially in the advanced economies (such as USA). Another factor, which contributed to the slowdown on the ETF market, were declines of the local as well as foreign stock indexes in that period and the resulting decrease in the profits from investments into ETFs. It led to relative decrease in the attractiveness of ETFs compared to some categories of mutual funds, e.g. money market funds.

Below in this section, using the theoretical framework of innovation diffusion models, we demonstrate the analysis results of elaborated diffusion trajectories regarding ETFs in Mexico over the period 2002–2012. We focus on the share of ETFs in total assets of investment funds. As discussed above, regarding ETFs diffusion pattern, after the early phase of develop-

ment (diffusion), across the years 2005–2009 abrupt growth in the share of ETFs was observed, and since 2010 onward it slightly declined.

Graphical identification of ETFs development trajectories, suggests that innovation diffusion models (see 'Method of the Research' section), where diffusion pattern is approximated by logistic growth schema, may be an appropriate tool to assess dynamic and characteristic features of the analyzed process of ETFs growth. Henceforth, using non-linear least square estimation method, we estimate the model specified as:

$$ETF_i(t) = \frac{\kappa_i^{ETF}}{1+exp\,(-\alpha_i^{ETF}(t-\beta_i^{ETF}))} \tag{7}$$

where κ_{ETFs} stands for saturation level of total market with ETFs (growth limit), α_i^{ETF} indicates the rate of ETFs diffusion, and β_i^{ETF} is the midpoint indicating the time when 50% of κ is reached.

Table 3 (see below) comprehensively summarizes the results of estimation of models specified as in Eq.(7).

When analyzing the diffusion of ETFs across Mexican investment funds market, the first thing to notice is that until 2012 the process of diffusion was still in the initial growth phase (to compare see visualization in Figure 2). For this reason, all the returned estimates should be interpreted carefully. As demonstrated in Table 3, the parameter κ, indicating the potential limit of growth of share of ETFs, followed the sigmoid diffusion pattern, is estimated at κ=8.26 and this result is statistically significant. The latter suggests that, under rigid assumption set for logistic growth model, the share of ETFs in Mexican investment funds markets should barely reach 8.26%. This probable underestimate is potentially due to the fact that the share of ETFs after reaching a 'peak' in 2010, has slightly decreased; hence the final estimated upper ceiling value may be violated. The estimated Tm (midpoint) is 2006.5, which means that in the year 2006 (5th month) the ETFs saturation level reached the half of its estimated upper growth limit. The rate of diffusion, indicated by α parameter, is 1.67 and following the specification in Eq.(4) is used to calculate the specific duration (Δt), which resulted to be 2.66 years. The calculated specific duration shows that across the analyzed period 2002–2012, it took only 2.66 years to grow in ETFs saturation from 10% to 90% of their maximum estimated market share in total Mexican investment funds market. The short specific duration is mainly due to the fact that initially ETFs were diffusing slowly while after the take off their share started to increase rapidly.

To provide more extensive evidence on ETFs diffusion in Mexico, we consequently demonstrate predictions regarding potential future diffusion

of ETFs. The results of our predictions are summarized in Table 4 and graphically plotted in Figure 4. All predictions are made under the rigid assumption that ETF market development trajectory will follow the logistic growth patterns, and hence should be read critically and carefully interpreted.

In our predictions we wish to find the rate of diffusion (α), specific duration (Δt) and midpoints Tm, if we presumed that consecutive parameters κ are fixed. Hence we run the predictions for κ=15, κ=20, κ=30, κ=50, κ=75 and κ=100, which allows us answering the questions under which conditions (in here specified by certain parameters of diffusion model) the ETFs share would reach, for instance the 50% of total investment funds market in Mexico.

The predictions summarized in Table 4 may be interpreted as follows. For instance, κ=30 indicates that we predict the ETFs to gain the share of 30% in Mexican investment funds market. Hence if the rate of diffusion is α=0.21, the predicted specific duration is 20 years which means that it would take 20 years to gain from 10% to 90% out of fixed 30% share of ETFs in investment funds market. At the same time, we conclude from Table 4 that if κ=30, the predicted midpoint would be by the year 2015. We additionally must note that predictions for further periods may be heavily violated, which is also indicated by decreasing R of the models. Moreover, predictions for κ=50, κ=75 and κ=100 are purely hypothetical (see figure 4). Bearing in mind the fact that in most developed countries like, for instance, the United States or Japan, the ETFs share in investment funds market is at around 10%, it is not very probable that within the next years their share in Mexico would grow so radically. Hence all these predictions show solely the hypothetical development trajectories and shall be treated as such.

Conclusions

In this paper we have intended to contribute to the present state of the art by providing the in-depth insight into the process of development of exchange traded funds in Mexico over the period 2002–2012. We have analyzed the problem using models of diffusion of innovation, which constitutes a novelty in this area of research.

Regarding both the absolute value of ETFs' assets and their share in investment funds market in Mexico, we have reported rapid and dynamic growth of this category, particularly visible in the years 2006–2009 (exponential growth), followed by the stabilization phase from 2010 onwards.

Causes of the fast development of the Mexican ETFs include, among others, growing diversity of the ETF category, increased competition among the providers of ETFs, cross listing of ETFs (mostly US ones), legal changes and wider implementation of ICT.

We have found that the trajectory of the ETF market development may be well approximated by logistic growth model, and hence the estimation of parameters of model of innovation was possible. The results prove the fast rate of ETFs diffusion in Mexico. Logistic growth model was also used to make predictions regarding future development of the ETF market in Mexico — further increase in the share of ETFs in the investment funds market may be predicted yet the maximum plausible level that can be reached until the end of current decade seems ca. 20–30%.

Further research in this topic could include application of the logistic growth models to ETF market development in other countries and comparison of the results with the ones obtained for Mexico. Moreover, analysis of the factors influencing the speed of diffusion and trajectory of the Mexican ETF market development may also be conducted in order to determine the key growth determinants of financial markets, and impulses which enforce their restructuring.

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Annex

Table 1. Exchange Traded Funds and mutual funds: comparison of selected features

Feature	ETFs	Index funds
Distribution channels	stock exchanges	bank offices, bank representatives, financial advisers
Valuation	updated, continuous valuation during trading hours; price of the units depends on demand and supply	value determined usually once a day by the managing company
Tracking errors	low due to arbitrage transactions	higher than ETFs'
Costs	very low: mostly costs of stock transactions	higher than ETFs': depend on the distribution and management fees

Source: own compilation based on Agapova (2011), IMF (2011, pp. 68-69), Lechman and Marszk (2015), Marszk (2014, pp. 206-207), Ramaswamy (2011, pp. 1-4).

Table 2. Summary statistics on assets under management of ETFs and mutual funds in Mexico. 2002–2012

	Exchange Traded Funds	Mutual Funds	Total Market
Absolute Values			
2002 – in mln USD	110	30 759	30 869
2012 – in mln USD	8 726	112 201	120 927
Mean – in mln USD	4 062	65 208.7	69 271
Min. Value – in mln USD	110	307 590	30 869
Max. Value – in mln USD	8 726	112 201	120 927
Average annual growth rate (2002-2012), in %	39.6	11.7	12.4
Shares in Total Investment Funds Market (in %)			
Share in Total Market in 2002	0.4	99.6	-
Share in Total Market in 2012	7.3	92.7	-
Mean	4	95	-
Min. Value	0.4	89.7	-
Max. Value	10.3	99.7	-
Average annual growth rate (2002-2012)	27.2	-0.6	-

Source: own calculations based on data derived from BlackRock (2011, 2012), ICI (2008, 2013).

Table 3. Logistic growth model estimates. ETFs in Mexico. Period 2002–2012

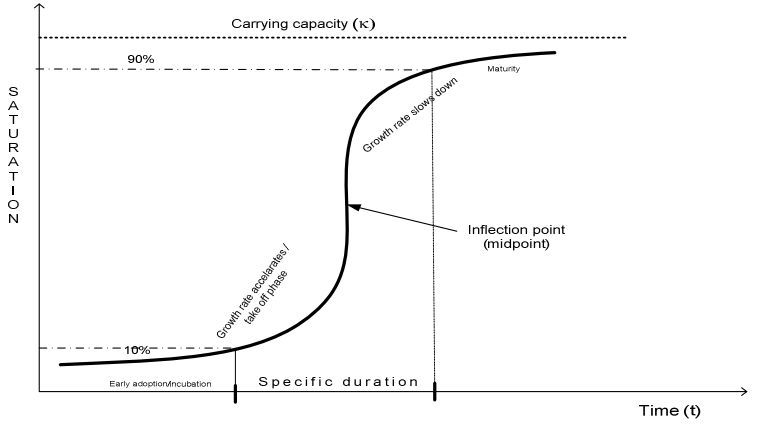
	Exchange Traded Funds
κ (ceiling/upper asymptote)	8.26 (.51)
Tm (β) (midpoint)	2006.5 (.25)
α (rate of diffusion)	1.67 (.60)
Δt (specific duration)	2.66
# of obs.	11
R-squared of the model	.97

Note: below coefficients – standard errors

Table 4. Period 2002–2012 Predicted ETFs development patterns

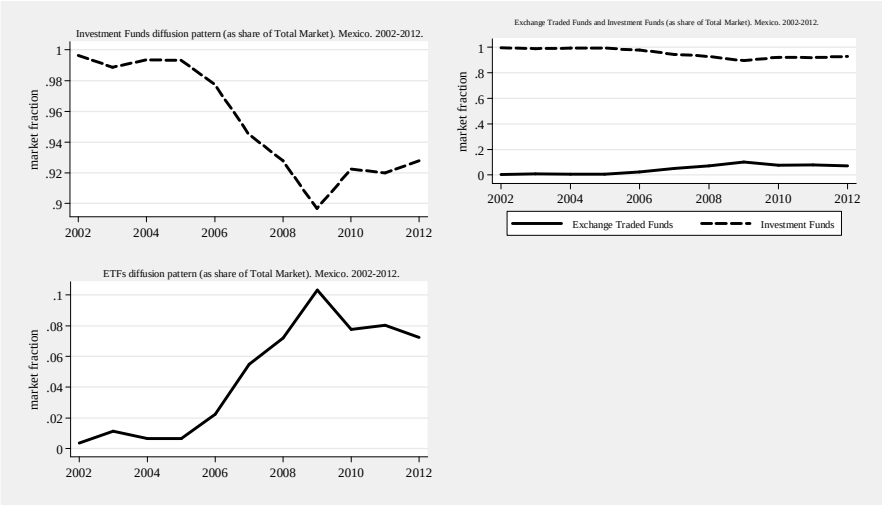
	15 (fixed)	**20 (fixed)**	**30 (fixed)**	**50 (fixed)**	**75 (fixed)**	**100 (fixed)**
κ (ceiling/upper asymptote)	15	20	30	50	75	100
Tm (midpoint)	2009.8	2012.0	2015.2	2019.1	2022.1	2024.2
α (rate of diffusion)	.32	.25	.21	.19	.18	.18
Δt (specific duration)	13.7	16.9	20.0	22.4	23.6	24.2
R-squared of the model	.74	.71	.69	.67	.67	.67

Figure 1. S-shaped diffusion trajectory. Theoretical specification



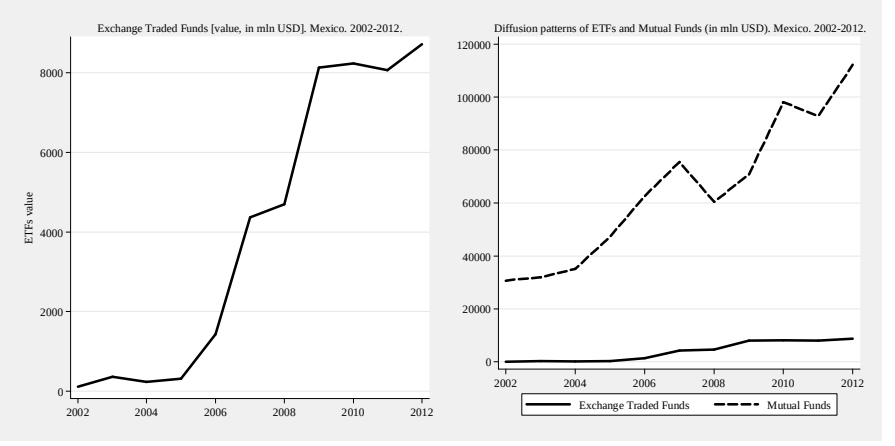
Source: Lechman (2015, p. 43).

Figure 2. Shares of Exchange Traded Funds and mutual funds in total investment funds in Mexico, 2002–2012



Source: own elaboration based on data derived from BlackRock (2011, 2012), ICI (2008, 2013).

Figure 3. Assets of Exchange Traded Funds and mutual funds in Mexico. Period 2002–2012



Source: own elaboration based on data derived from BlackRock (2011, 2012), ICI (2008, 2013).

Figure 4. Predicted ETFs diffusion trajectory. Mexico. 2002–2040