EQUILIBRIUM
Quarterly Journal of Economics and Economic Policy
Volume 13 Issue 4 December 2018
p-ISSN 1689-765X, e-ISSN 2353-3293
www.economic-policy.pl

ORIGINAL PAPER

Citation: Marszk, A. (2018). Exchange-traded products in Germany: development and substitution of exchange-traded funds, exchange-traded commodities and exchange-traded notes. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *13*(4), 643–665. doi: 10.24136/eq.2018.031

Contact: adam.marszk@zie.pg.gda.pl, Gdańsk University of Technology, Faculty of Management and Economics, Narutowicza 11/12, 80-233 Gdańsk, Poland
Received: 23 May 2017; Revised: 20 August 2018; Accepted: 29 August 2018

Adam Marszk
Gdańsk University of Technology, Poland

Exchange-traded products in Germany: development and substitution of exchange-traded funds, exchange-traded commodities and exchange-traded notes

JEL Classification: *G11; G12; G23; O16*

Keywords: *exchange-traded funds; exchange-traded products; financial innovations; stock exchange; Germany*

Abstract
Research background: Exchange-traded products (ETPs) are one of the most rapidly growing categories of financial products. Their fast development has been boosted by innovative features. Three main categories of ETPs are exchange-traded funds (ETFs), exchange-traded commodities (ETCs) and exchange-traded notes (ETNs). ETCs and ETNs remain least known, even though their number on some stock exchanges is high. In Europe, Germany is one of the largest and most active ETPs markets. ETCs and ETNs are debt instruments, in contrast with the most popular ETFs, which are equity securities. Therefore, they offer investors different advantages, but also expose them to other types of risks.
Purpose of the article: The key aim of the article is to present the features of ETPs and to provide in-depth insight into the issues linked with the development of ETPs market in Germany, with the special emphasis on the ETCs and ETNs.
Methods: In the main empirical part of the article, German ETPs market is analyzed using descriptive statistics and technological substitution framework (employed for the analysis of innovations in order to evaluate the changing market shares of, first, ETFs versus ETCs and ETNs, as well as, second, ETFs versus other types of investment funds). The period of the analysis is 2010–2016 in the former case and 2007–2016 in the latter.

Findings & Value added: Share of ETPs other than ETFs in the total market in Germany remains low. Even though the market position of the leading products, i.e. ETFs, is still very strong, some substitution has been observed, especially after 2015. Predictions indicate that this trend will continue in the upcoming years. The results of the analysis of the investment funds' market confirm the substitution between ETFs and traditional investment funds over 2007–2017, in particular in the first years of this time period.

Introduction

Exchange-traded products (ETPs) are one of the most rapidly growing categories of innovative financial products. Their fast development in various countries has been boosted by innovative features which facilitate gaining advantages relative to the conventional products (e.g. mutual funds). Three main categories of ETPs are the most popular exchange-traded funds (ETFs), exchange-traded commodities (ETCs) and exchange-traded notes (ETNs). ETCs and ETNs remain relatively least known among participants of financial markets. In Europe, German Xetra trading system (part of the Deutsche Börse group) is one of the largest and most active ETPs trading venues, where a significant share of European ETCs and ETNs transactions is conducted. ETCs and ETNs are debt instruments, in contrast with ETFs which are equity securities. They have been in use for a much shorter period than ETFs — they may be regarded as innovation in relation to the previous innovation (ETFs) as they emerged as a new form of investing. Therefore, they offer investors different advantages, but also expose them to other types of risks. The key purpose of the article is to present the most important features of three categories of ETPs and to provide the in-depth insight into the issues linked with the development of ETPs market in Germany, with the special emphasis on the role of ETCs and ETNs. Additionally, development of the ETPs market Germany is also studied in a slightly different perspective by analyzing the market share of the largest category of ETPs, i.e. ETFs, in the total market for investment funds in Germany. To the best of our knowledge, it is one of the few articles to address the issue of transforming ETPs market structure and the first one in which the structure of the ETPs market has been analyzed using not only descriptive statistics, but also with the technological substitution model, adapted to the analysis of the financial markets.

The structure of this paper is as follows. The first section provides the literature review, including the theoretical background and results of the previous studies devoted to ETPs. The second section outlines the methodological setting. In section three the empirical results are presented. The paper concludes with the fourth section.

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Literature review: features, comparisons, advantages and disadvantages of various categories of exchange-traded products

Exchange-traded funds (ETFs) are one of the most significant groups of financial innovations introduced in the recent decades, with increasing impact on the financial system. ETFs are heterogeneous group of financial products yet they share some common features which, when considered together, distinguish them from other types of financial products, especially the traditional ones (Lechman & Marszk, 2015, pp. 355–360; Abner, 2016, pp. 282–283; Hill, 2016, pp. 8–13):

- shares of ETFs are listed and traded on publicly accessible stock exchanges;
- shares of ETFs are not sold directly to investors by the issuers, but rather with the intermediation of authorized participants who trade in large blocks (called 'creation units');

Mutual funds, traditional financial products, which may be considered the main alternative to ETFs, in a vast majority can be only purchased or redeemed through conventional channels, such as bank offices or financial advisors (Agapova, 2011, pp. 323–330). Moreover, the difference in the distribution method results in higher liquidity, more frequent valuation and usually lower tracking cost and error of ETFs than in the case of mutual funds. More generally, total expense ratios (TER) of ETFs have been declining globally in the recent years due to the more intensive competition between the funds' providers resulting from, *inter alia*, increasing number of financial companies entering this market. The weighted average TER of ETFs in Europe was at the end of 2016 at ca. 31 bps; for the largest funds it was usually below 20 bps, in some cases even under 10 bps (MacManus & Lee, 2017, p. 79).

Most ETFs are instruments for passive investing, which means that their users receive returns resembling returns of other assets, most often equity indices (i.e. they track the indices). As a result, their users strive to decrease the tracking error and cost. However, over the recent years many new types of ETFs have been developed, which can be used as tools for active or semi-active investing, e.g. smart beta (enhanced indexing) ETFs whose providers modify the weights of the assets in their portfolios in relation to their benchmarks (Deutsche Bank, 2015, p. 72). Other examples include leveraged, inverse or leveraged-inverse ETFs, which offer positive or negative multiple of the rates of returns on the tracked assets (Leung & Santoli, 2016, pp. 1–5), as well as currency hedged ETFs whose providers use derivatives in order to hedge against the changes in the exchange rates (Shank & Vianna, 2016, pp. 430–432). The demand for the new categories of ETFs

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has been increasing due to a number of factors, including the increased volatility on the financial markets.

ETFs are not the only category of exchange-traded products (ETPs). Two other major groups of ETPs are ETCs and ETNs. However, ETFs are the oldest (first ETFs had been launched in the late 1980s) and the largest class of ETPs. ETFs are equity instruments, parallel in their trading mechanisms to stocks of listed companies. ETCs are a group of ETPs which offer users rates of return linked to commodities (single or baskets of such assets) or, much less frequently, to currencies (Deutsche Bank, 2015, p. 71). ETCs are debt instruments, similar to bonds issued by banks, backed by the issuer's credit. Despite some initial differences in the details of their construction (e.g. legal structures or status of the debt holder (Deutsche Bank, 2010, pp. 19–30)), currently structures of ETNs are very similar to ETCs — they are both debt instruments (very similar to undated zero-coupon bonds). One of the very few remaining technical differences is the method of replication: ETCs use both physical and synthetic replication (first is based on the purchase of tracked assets, second on swaps or other derivatives) while ETNs use exclusively synthetic. The biggest difference refers to the covered type of assets: ETNs track returns of indices other than commodities markets, for instance, volatility indices, stock indices (short or long, with or without leverage), interest rate futures and currencies (in some countries such products are categorized as ETCs). Distinction between ETNs and ETCs based on the tracked asset classes has also been applied on the German market, including Xetra platform, which will be analyzed in the empirical section. In some publications these two names (ETCs and ETNs) are used interchangeably and describe debt ETPs tracking all types of assets.

In order to understand the reasons why market participants may switch from ETFs to ETCs or ETNs, the advantages and disadvantages of all three categories should be discussed in comparative perspective (see Table 1). Relative benefits of ETCs or ETNs include (Ferri, 2009, p. 54; Hill *et al.*, 2015, pp. 39–40):

- lower tracking error – ETCs and ETNs have no tracking error apart from some differences caused by the fund expenses;
- broader and more flexible access to unique markets or strategies (e.g. with high leverage or inverse returns), often unavailable or difficult to reach through ETFs (especially physical); ETCs and ETNs can be used, for instance, by small investors to gain returns linked to derivatives);
- cheaper hedging applications (e.g. hedging of foreign exchange risk);

Using ETC or ETNs exposes investors to some types of risks which are very uncommon or even not present in case of ETFs (for a full overview of

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the risk factors see the report by Financial Industry Regulatory Authority (2012)):

- credit risk of the issuer: value of the ETC or ETN may decrease due to factors unrelated to the tracked assets, such as credit rating downgrade of the bond's issuer;
- counterparty risk: the default of the issuer may lead to a partial or complete loss of the invested capital (Cserna *et al.*, 2013, pp. 70–75).

The number of studies concerning ETPs (above all ETFs) has been growing quickly since the early 2000s. Chronologically, some of the first studies on this topic focused exclusively on ETFs and include Elton *et al.* (2002, pp. 453–472) with the analysis of the world's largest fund's (SPDR) performance, Curcio *et al.* (2004, pp. 123–138) who investigated the turnover and performance of the ETF tracking NASDAQ 100 and confirmed rare deviations from the net asset values, and Cherry (2004), who analyzed the arbitrage on the ETFs market, finding violations of the market efficiency.

More recently, the most frequently covered topics include:

- liquidity of the units of ETPs (Czauderna *et al*., 2015, pp. 454–459; Ivanov, 2016, pp. 249–259; Marshall *et al.*, 2018) or the impact of ETPs on the underlying (tracked) assets (Madhavan, 2012, pp. 20–35; Krause & Tse, 2013, pp. 244–259; Lin, 2016, pp. 279–284; Dannhauser, 2017, pp. 537–560);
- arbitrage mechanism on the ETPs markets (Marshall *et al.*, 2013, pp. 3486–3498; Charteris *et al.*, 2014, pp. 80–89; Hilliard, 2014, pp. 90–107);
- various aspects of pricing and performance of ETPs (Aroskar & Ogden, 2012, pp. 2047–2062; Blitz *et al.*, 2012, pp. 649–662; Yannaki, 2015, pp. 955–966; Chen *et al.*, 2017, pp. 443–462; Petajisto, 2017, pp. 24–54).

In the previous paragraphs of this section. key publications that concentrated on the comparisons of the categories of ETPs were presented. However, the other key topic of this paper, i.e. the ETPs market development (the diffusion and substitution of ETPs) and changes in its structure, is rarely considered. Lechman and Marszk (2015, 2018) and Marszk *et al.* (2017, pp. 83–100) investigated the diffusion of ETFs in selected developed and emerging economies (with the application of logistic growth models), proving the occurrence of this process. Hull (2016, pp. 613–636) studied the spread of financial innovation using the model with two classes of agents and examined the equilibrium on the markets for financial innovations — results obtained for ETFs in the United States confirm they persistence. Vandermarliere *et al.* (2017, pp. 111–123) examined the structure of the ETFs market, divided according to the funds' market capitalization, yet

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they focused exclusively on the equity ETFs; the applied research method was spectral analysis of residuals and analysis of the generalized derivative. Lettau and Madhavan (2018, pp. 135–154) investigated the main groups of ETFs and studied the structure of the global ETPs market, providing some insights into the shares of various groups.

This paper contributes to the literature in two ways. It is the first to study in detail the German ETPs market's structure. Moreover, it uses novel methodological approach as the structure of the ETPs market is analyzed with the technological substitution model — such approach has not been adopted previously to investigate the shifts in turnover (or assets) between various categories of ETPs.

Research methodology and data

In the first empirical part of the article, descriptive statistics are used to present the key trends on the ETPs market, as well as to briefly characterize its structure. In the second, main empirical part of the article, German ETPs market is analyzed preliminarily using descriptive statistics. In order to more accurately and reliably evaluate the occurrence and degree of substitution between the three types of ETPs on the German market, the technological substitution framework is applied. ETCs and ETNs are considered to be financial products even more innovative than ETFs (e.g. due to their different features), therefore the possible substitution between ETFs and ETCs/ETNs (considered together) is investigated. The same method is used to explore the changes taking place on the investment funds' market, i.e. between ETFs and traditional types of investment funds (e.g. mutual funds or closed-end funds).

The technological substitution model is used to explain the changing market shares of technologies (Kucharavy & De Guio, 2011, pp. 408–413; Lechman, 2015, p. 46), but it may be also applied to financial products. It is based on the assumption that the total sum of market participants using two competing products is fixed. In this research, a three-parameter logistic substitution model was applied, following the methodology of Marchetti & Nakicenovic (1979, pp. 1–8). In the case of two different products which replace each other, N_i represents the number of users of each product. Share of market participants using certain product i at time t can be stated as (Lechman, 2015, p. 47):

$$f_i(t) = \frac{N_i(t)}{N} \tag{1}$$

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Diffusion of the innovative products is expected to follow three stages: a logistic growth stage, (growth rate is initially slow); an exponential growth stage (of rapid diffusion); and the saturation stage (product reaches maximum market share). Therefore, as Kwaśnicki (2013, pp. 50–60) shows, innovative products follow a logistic growth trajectory. It is very important to identify the times when substitution stages start and finish. According to Meyer *et al.* (1999, pp. 247–257), the estimate of the time when the saturation stage stops is given by:

$$\frac{y_i''(t)}{y_i'(t)} \to \min. \tag{2}$$

where $y_i(t)$ is the market share of product i according to Fisher-Pry transformation (Fisher & Pry, 1972, pp. 75–88):

$$y_i(t) = \ln\left[\frac{f_i(t)}{1-f_i(t)}\right] \tag{3}$$

After estimating y_i and y_i', it is thus possible to estimate the two crucial parameters of the logistic curve for product i, which can be expressed as (Meyer *et al*., 1999, pp. 247–257):

$$\Delta t_i = \frac{\ln(81)}{y_i'(t)} \tag{4}$$

And

$$T_{m_i} = \ln\left[\frac{\left(y_i(t)-\frac{\ln(81)}{\Delta t}\right)}{\frac{\ln(81)}{\Delta t}}\right]. \tag{5}$$

Δt_i shows the time needed for product i to increase its share in the combined market for two products from 0.1 to 0.9 (i.e. from 10% to 90%) and T_{m_i} represents the mid-point, i.e. point in time when the substitution process is half complete (market shares of both products are equal to 50%). In the first, main part of the substitution analysis we investigate the substitution between older, equity products (ETFs) — the first category, and newer, debt products (ETNs and ETCs) — the second category, which may be regarded as even more innovative and able to take over market shares of more established ETFs. The total market is the ETPs market. In the second, supplementary part of the analysis, analogous approach is used to study the German investment funds' market by examining the changing market

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shares of ETFs (regarded as innovative category) and traditional, more established funds.

Trends on the global ETPs market are presented for the last 10 years: 2007–2016. Due to data availability, the period of the substitution analysis between ETFs, ETCs and ETNs in Germany is 2010–2016 and monthly data are used (i.e. 79 observations). Substitution analysis of the German investment funds' market is conducted for the period 2007–2016 and quarterly data are used.

Data were extracted from the Lipper's database, datasets of ETFGI Global, Deutsche Bank, local stock exchanges and from the reports published by Deutsche Börse. Monthly Xetra transaction reports were used to construct unique database which contains data on the German ETPs. The key indicators used to reach the stated aim are the values of turnover of ETFs, ETCs and ETNs (in EUR millions) in the first part of the substitution analysis, and, in the examination of the key attributes of the European and German market as well as in the second, complementary part of the substitution analysis, the values of assets under management (in EUR millions). The turnover indicator has been chosen as the primary in the first part of the substitution study as it most accurately reflects the development of the ETCs or ETNs for which asset values may be misleading due to the fundamental attributes of these products (i.e. debt instruments). Structure of the ETPs market is evaluated through the analysis of market shares (i.e. share of given category of ETPs in the total turnover of ETPs).

Results

The global ETPs market has been developing rapidly over the last several years, in all possible dimensions, e.g. assets (measured using assets under management, AUM) and number of listed products. In the last 10 years, between 2007 and 2016, assets under management of all globally listed ETPs have increased by ca. 314%, from 857 to 3546 bln USD (ETFGI, 2017, p. 4). The number of listed ETPs has grown from 1545 to 6625. For an overview of the trends in the last decade see Figure 1. Rapid development of the ETPs market has been almost unaffected by the 2008 financial crisis.

The share of ETPs other than ETFs in the global market remained minimal, between 5 and 12%. However, in absolute terms their assets have grown significantly in the 2007–2016 period — from 50 to 151 bln USD; the growth of ETFs has been, though, even faster (ETFGI, 2017, p. 4). Using data from the major stock exchanges and reports published by financial

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institutions (Deutsche Bank, 2017, p. 42; ETFGI, 2017, p. 4), the assets of all globally listed ETCs in 2016 were estimated at ca. 27 bln USD and assets of ETNs at ca. 30 bln USD (ca. 22 bln USD listed in the USA and ca. 8 bln USD outside USA).

The total assets under management of ETPs primary listed in Europe (see Figure 2) reached at the end of 2016 the record-high level of almost 550 bln EUR; for Germany, the respective value was approximately 150 bln EUR, which shows its strong position in the region. In comparison with the beginning of 2007, it meant an increase of more than 500%. Generally, the observed trends were very similar to the ones that could be noticed for the entire global market (compare Figures 1 and 2). The structure of the European ETPs market in terms of asset classes has been rather stable over 2007–2017 (see Figure 3) and no substantial changes were noticed — the largest category were equity products with ca. 70% share, followed by fixed income product whose share was at approximately 20% (the share of other categories ranged between 3 and 12%). The structure of the German market was similar. However, over the next years the share of non-equity ETPs may start to grow as already in 2016 the fixed income ETPs became the European market leader when cash flows are considered (see Figure 4) — sustainability of this trend remains to be observed. Furthermore, focusing on ETFs — the main category of ETPs, it may be added that, according to data for the 2013–2016 period (data for 2010–2012 were not available) inflows to ETFs contributed primary to the growth of assets of ETFs listed in Europe: the average monthly flows contribution was at ca. 1% whereas the contribution of the changes in the prices of held assets was at ca. 0.54% (Deutsche Bank, 2015, 2017).

According to data for 2016 (Deutsche Bank, 2017), German ETPs market was one of the largest not only in Europe, but also globally (yet still smaller than US or Japanese). According to the values of assets or turnover, it is the second-biggest in Europe (lagging behind only the UK). The number of listed ETPs is similar to the UK. First ETFs had been launched on Deutsche Börse in the early 2000s, ETCs in 2006 and ETNs in 2009.

All of the 10 largest ETPs in Germany as of 2016 were ETFs (see Table 2), even the biggest ETNs or ETCs were much smaller. Most of the ETFs listed in Germany with the largest assets were equity funds (there were only two funds with exposure to the corporate bonds on the list), which corresponds to the overall structure of the local market, with the domination of the products tracking stock market indexes. The total return of all leading ETPs was positive in 2016, the highest was achieved by the funds with exposure to the US equities.

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Due to reasons outlined in the methodological section, the key indicator applied in the main part of the substitution analysis is the turnover of ETPs' units (see Table 3). All data on turnover of ETPs in Germany were extracted from the monthly cash market reports published by Deutsche Börse (Xetra, 2017). The value of the total monthly ETPs' turnover was very similar at the beginning and end of the analyzed time period — it was at ca. 14 bln EUR, which shows that the market development in this perspective has been almost non-existent (despite the considerable increase in the total assets mentioned in the preceding paragraphs). Lack of development measured using the turnover indicators is also proven by the mean ETPs' turnover value which was at ca. 13.26 bln EUR (i.e. lower than the initial value). Maximum turnover was observed in the second half of 2011. Slowdown in the following years may be attributed to various factors, among them market-specific such as declining overall activity on the German capital market (stock and bond turnover have also been declining), and regional, e.g. the euro-zone debt crisis.

Structure of the German ETPs market has been evolving in the analyzed time period (see Table 3 and Figure 5), but it is difficult to determine the exact trends (detailed discussion of substitution will be presented in the next paragraphs). ETFs have been the most actively traded category of ETPs in Germany over the whole period (similarly to all other world's ETPs markets), with the maximum share in the total ETPs turnover of 98.1%, reached in October, 2014. The minimum market share of ETFs was observed several months earlier, in April, 2013 (90.4%) which shows the high rate of changes.

In order to more accurately describe the changes occurring in the structure of the German ETPs market, and, even more importantly, to evaluate the observed and potential substitution, total market was divided into two categories: first — ETFs (as more established, equity products), second — ETCs and ETNs (as newer, more innovative, debt products). Substitution between those two categories was analyzed. It should be added that substitution between ETCs and ETNs may be regarded as negligible because, according to the classification applied by Xetra, they offer different types of exposure — they are thus products which may be perceived as complimentary.

In the first half of the discussed time period, the share of ETFs was at rather stable level between ca. 93.5 and 94.5%. It started increasing in the second half of 2013, reaching the highest level in the late 2014 and 2015 (at ca. 97.5%). However, since the end of 2015 it decreased quickly, which means that, at the same time, market share of ETCs and ETNs grew — at the end of 2016 it amounted to almost 5.3% (the highest level since 2013).

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Therefore, it seems that over 2010-2016 there were three stages: first — stability between 2010 and 2013; second — strengthening position of ETFs between 2013 and 2015; and, finally, third — growing share of debt ETPs since late 2015.

Substitution model was used to estimate the parameters T_{m_i} and Δt_i for combined ETCs and ETNs versus ETFs (see Table 4). If the full sample period is taken into account (June, 2010 — December, 2016), no conclusions can be stated — the process is not definite and the estimated parameters are insignificant. Nevertheless, based on the preliminary analysis discussed in the previous paragraphs, sub-sample periods were examined.

The period December, 2015 — December, 2016 (see Table 4 and Figure 6; month no. 67 = December, 2015) is the only sub-sample period for which the estimated parameters are statistically significant. From December, 2015 ETCs and ETNs gradually increased their market position (from ca. 2% to more than 5%) — it proves that they have a potential to win some market share. According to the estimates for this sub-sample period, T_{m_i} = 122.453 months which means that estimated time when ETCs and ETNs will reach 50% market share (in the total ETPs market) is at ca. 122 month, i.e. in July, 2020 (if further market development will follow path predicted by logistic substitution model, typical for innovations, such as financial). Estimated takeover time, Δt_i, time needed for the market share of ETCs and ETNs to grow from 10 to 90% (i.e. in the stage of rapid diffusion), is ca. 70 months. It applies to predicted development as the empirical market share was below 10%. Such market share is expected to be reached at ca. month no. 85, i.e. in June, 2017. The share of ETCs and ETNs of 10% seems feasible as in the past (in some months of 2013), ETCs considered alone reached market share close to this level. Projections for the longer period are not presented, but the direction of expected changes is clear — ETCs and ETNs are predicted to be the 'winning' products.

It should be stated, though, that due to various factors (such as much higher awareness of their features among investors) ETFs are expected to remain the dominant class of ETPs in the upcoming years. ETCs and ETNs are still relatively new products but they may gradually increase their market share due to their innovative features. This change will be caused mostly by ETCs as ETNs remain a product of minor importance. Most factors (including legal and regulatory environment) are rather similar for all types of ETPs, correspondingly their users or applications — the exact determinants of substitution remain to be identified.

As the second part of the substitution analysis and a supplement to the previous discussion, changing market shares of ETFs and traditional funds over 2007–2016 were examined. Again, substitution framework was ap-

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plied — values of the two key parameters are presented in Table 5 (for the graphical evidence see Figure 7). In contrast with the results obtained in the analysis of the ETPs market, in this case some robust conclusions may be formulated for the estimates based on data for the full sample period. Substitution was reported and the returned estimated of parameters are statistically significant (there are no misspecifications); path of changes in time seems to follow closely the trajectory assumed in the applied model (see Figure 7).

In the examined time period the share of ETFs in the total investment funds' market has increased substantially, from below 2% in the first quarter of 2007 to over 7% at the end of 2016; the maximum share was reached in the late 2015 and it was close to 8%. As it may be noticed on Figure 6, the most rapid expansion of ETFs took place between 2007 and 2011. However, despite the growth, the position of the innovative funds has remained much weaker than the traditional funds. Predictions that may be formulated for the next years (up to 2025 — see Figure 7) confirm that ETFs may be reasonably expected to reach the market share of approximately 20%. Values of the estimated parameters of the substitution model (see Table 5) confirm the conclusions concerning further expansion of ETFs, yet they also indicate that traditional funds may be projected to stay the main group in the next decades. Midpoint, T_{m_i}, was estimated at ca. 2041, which means that ETFs are expected to reach 50% market share approximately in 2041. Takeover time, Δt_i was estimated at ca. 46 years which further proves that it is difficult to claim that ETFs will completely evade the German investment funds' market (to large extent such conclusion would be too far-reaching due to partially different applications of various categories of investment funds). Nevertheless, the direction of changes seems to be clear and in favor of ETFs.

For comparison, a model that entails the same time period as considered previously in the analysis of the ETPs substitution was estimated, i.e. for 2010–2016 (see bottom part of Table 5). Estimated values of both T_{m_i} and Δt_i are much lower than the ones returned for the full sample period, thus confirming the slowdown of the expansion rate of ETFs after 2011. It is worth noticing that the only substantial decline in the market share of ETFs took place in 2016, i.e. the only sub-sample period when expansion of ETCs and ETNs was identified. It proves that, to some extent, the debt products won the share of ETFs in the entire German investment industry.

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Discussion

The results of the first part of the conducted substitution analysis prove that substitution between ETFs and other categories of ETPs in Germany took place on a limited scale — it was confirmed only in the final years of the considered time period. Results for the previous months imply no substitution. As the substitution between ETFs and other categories of ETPs (or the development of the markets for ETCs or ETNs) was not analyzed in the prior studies, it is impossible to compare the obtained results with the conclusions presented in other publications.

The results of the supplementary analysis concerning substitution between ETFs and traditional investment funds may be compared to the results of the previous studies concerning the diffusion of ETFs. Analogously to the conclusions reached by Hull (2016, pp. 613–636) for the United States using data on the funds' flows, it was proven that expansion of ETFs occurred in Germany (based on data on assets). Moreover, in line with the results of the studies by Lechman and Marszk (2015, 2018) and Marszk *et al.* (2017, pp. 83–100), who addressed a number of non-European ETF markets (two Asia-Pacific: Japan and South Korea, and three American: Brazil, Mexico, and the United States) it was confirmed that also in Germany ETFs were penetrating the local investment funds' market and traditional funds were losing their market share. However, as in the abovementioned studies, the results of the conducted study prove that diffusion of financial innovations (i.e. development of their markets) is a complicated process and its trajectory is difficult to predict

Conclusions

This paper presents both the theoretical and empirical aspects of rapidly expanding innovative category of financial products, labeled together as exchange-trade products (ETPs). Three main types of ETPs are ETFs — equity products, the largest group both globally and in Germany, and ETNs and ETCs — debt products whose role remains much less significant. The position of the European market has become stronger over the last few years and the German market is the second largest in Europe, with ca. 430 bln EUR of assets at the end of 2016. Empirical findings indicate that share of ETCs and ETNs in the total ETPs market in Germany between 2010 and 2016 remained rather low, despite the quickly growing assets and turnover of some products. Even though market position of ETCs and ETNs is much weaker than the leading products, some substitution (yet still rather weak

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and of uncertain sustainability) between ETCs and ETNs was observed, especially since 2015. However, in the preceding months the substitution process was not definite which shows that the period of the expansion of ETCs and ETNs was rather short. Results of the supplementary analysis of the German investment funds' market confirm the substitution between ETFs and traditional investment funds over 2007–2017, in particular in the first years of this time period. Nonetheless, despite the increase in the market share of ETFs, it remained much lower than in case of more established funds. It should be stressed that the entire analysis was made under the rigid assumption that trajectory of changes on the analyzed markets followed and is projected to follow the logistic growth pattern. It means that the obtained results, in particular projections, should be interpreted carefully as the trajectory of changes may be different.

Even though most of the study was devoted to the German ETPs and investment funds' market, the results may be also referred to other countries, in particular in Europe. German market, one of the most developed in the region, may be regarded as benchmark for the other, especially less advanced ones, indicating possible future trajectories of the evolution of market shares of various types of ETPs or, more generally, changes between innovative and traditional investment funds. The results of the study, despite its mostly academic nature, can be considered by various participants of the ETPs markets as well as regulatory authorities. For the former, they may indicate the possible future changes on the highly competitive markets and be used in formulating the business strategies in long-term perspective; for the latter, they may serve as the basis for the evaluation of possible risks emerging from the evolution of the analyzed part of the financial system, both on the level of individual users and in terms of system-broad consequences.

Potential future research directions could include the analysis of the factors influencing the development of ETPs markets in various countries or regions, including Germany, particularly the determinants of their structures, explaining why some categories of ETPs, like ETNs, have failed to gain substantial market share.

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Acknowledgments

This article is a result of scientific project no. 2015/19/D/HS4/00399 financed by the National Science Centre of Poland.

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Annex

Table 1. Types of exchange-traded products: comparison of key features

	ETFs	**ETCs and ETNs**
type of instrument	equity	debt
similarity of assets in the portfolio to the benchmark	high (physical) or none (synthetic)	high (physical ETCs) or none (synthetic ETCs and ETNs)
replication method	physical or synthetic	physical (ETCs) or synthetic (ETCs and ETNs)
tracking error	low	very low or none
credit risk of issuer	no	yes
counterparty risk	very low or none	usually low but may be substantial in some rare cases

Source: own elaboration based on Deutsche Bank (2010, p. 20).

Table 2. Ten largest ETPs listed in Germany in 2016 (year-end classification according to assets)

Name of ETP	**Type of ETP**	**Exposure**	**Assets [mln EUR]**	**2016 total return in the fund's currency [%]**
iShares Core S&P 500 UCITS ETF	ETF	equity	18580.98	11.54
iShares Core DAX UCITS ETF (DE)	ETF	equity	8173.30	6.75
iShares Core MSCI World UCITS ETF	ETF	equity	8044.64	7.73
iShares Core Euro Corporate Bond UCITS ETF	ETF	fixed income	7662.72	4.64
iShares S&P 500 UCITS ETF (Dist)	ETF	equity	7592.69	11.17
iShares EURO STOXX 50 UCITS ETF (DE)	ETF	equity	7465.63	4.00
Lyxor UCITS ETF EURO STOXX 50	ETF	equity	7029.56	4.21
iShares MSCI Europe UCITS ETF (Dist)	ETF	equity	5854.35	2.65
iShares Euro High Yield Corporate Bond UCITS ETF	ETF	fixed income	5789.68	8.05
iShares STOXX Europe 600 UCITS ETF (DE)	ETF	equity	5533.55	1.58

Source: own elaboration based on Xetra (2017) and websites of the managing companies.

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Table 3. Summary statistics on turnover of exchange-traded products in Germany. Monthly data for June, 2010 — December, 2016

Turnover value [mln EUR]				
	ETFs	**ETCs**	**ETNs**	**Total ETPs**
Observations	79	79	79	79
Minimum	7 468.46 (2013m11)	212.49 (2014m4)	4.76 (2014m7)	7744.83 (2013m11)
Maximum	26 992.37 (2011m8)	2128.15 (2011m8)	197.38 (2010m11)	29230.98 (2011m8)
Standard deviation	3 463.43	287.58	38.09	3 634.67
Mean	12 644.58	565.67	51.38	13 261.62
Absolute change in value	-121.95	59.53	-14.65	-77.06
Share in total turnover of ETPs [%]				
	ETFs	**ETCs**	**ETNs**	**Total ETPs**
Observations	79	79	79	-
Minimum	90.43 (2013m4)	1.68 (2015m12)	0.05 (2014m7)	-
Maximum	98.10 (2014m10)	9.46 (2013m4)	1.55 (2010m10)	-
Standard deviation	1.69	1.60	0.28	-
Mean	95.33	4.29	0.38	-
Absolute change in share (pp)	-0.35	0.45	-0.10	-

Table 4. Estimated substitution models for the turnover of exchange-traded products in Germany

ETCs and ETNs *versus* ETFs	
Full sample	
-293.262 *-474.623*	Substitution process not definite.
Sub-sample	
2015m12 to 2016m12	
122.453 70.409	Substitution reported.

Source: own elaboration in the IIASA LSM2 software. Italics: misspecifications; T_{m_i}: estimated midpoint (market shares of both categories equal to 50%); Δt_i: estimated takeover time (time needed for ETCs and ETNs to increase their share in the combined ETPs market from 10% to 90%); estimates of both parameters in months.

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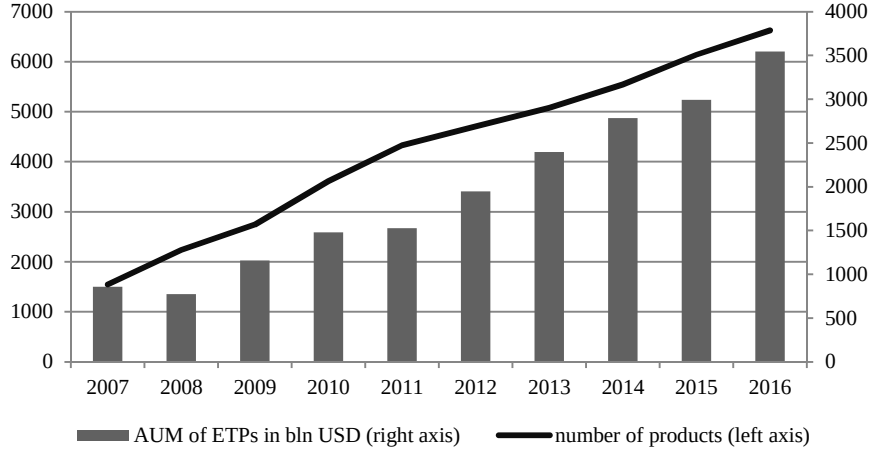
Table 5. Estimated substitution models for the German investment funds' market

ETFs *versus* traditional investment funds	
Full sample	
2040.69 46.18	Substitution reported.
Sub-sample	
2010q2 to 2016q4	
2109.64 163.45	Substitution reported.

Source: own elaboration in the IIASA LSM2 software. Italics: misspecifications; T_{m_i}: estimated midpoint (market shares of both categories equal to 50%); Δt_i: estimated takeover time (time needed for ETFs to increase their share in the investment funds' market from 10% to 90%); estimates of both parameters in years.

Figure 1. Global assets under management (AUM) and number of exchange-traded products between 2007 and 2016



Source: own calculations based on ETFGI (2017, p. 4)

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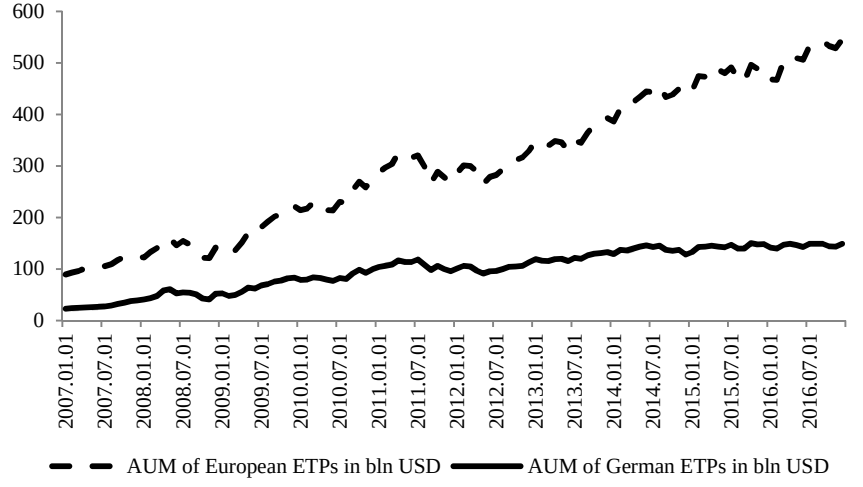
Figure 2. Assets under management of exchange-traded products listed in Europe and Germany according to the location of primary listing (January, 2010 — December, 2016; in bln EUR)



Source: own calculations based on data extracted from the Lipper's database.

Figure 3. Structure of the European exchange-traded products market in terms of asset classes (classified according to assets under management) between 2007 and 2016

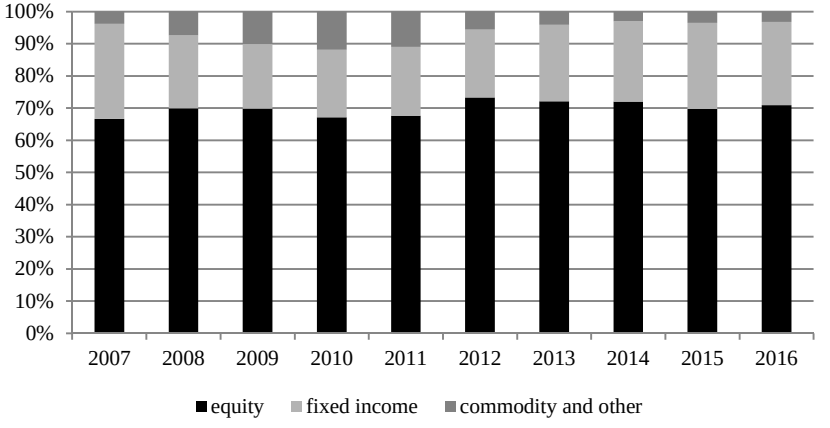


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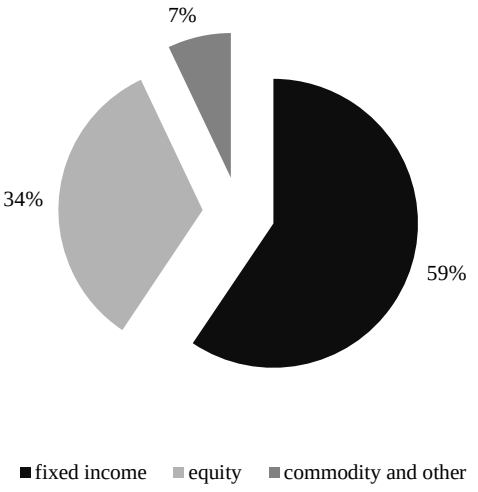
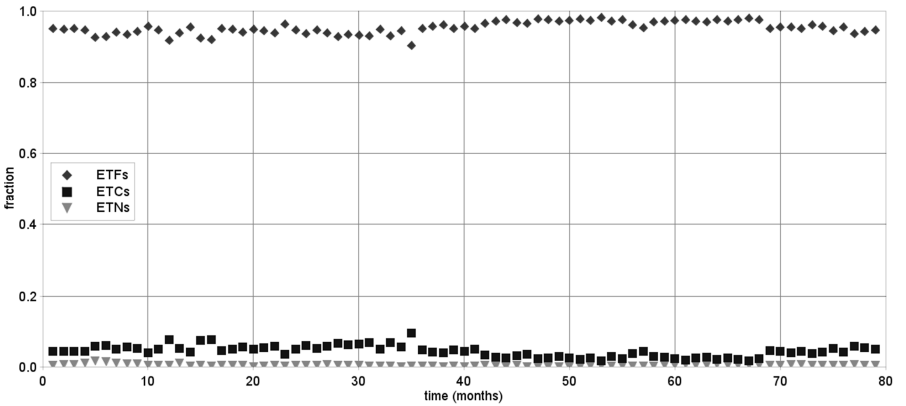
Figure 4. Structure of the European exchange-traded products in terms of asset classes (classified according to cash flows) in 2016



Source: own calculations based on Deutsche Bank (2017).

Figure 5. Market shares of exchange-traded funds, exchange-traded commodities and exchange-traded notes in Germany (share in the total turnover of exchange-traded products, monthly data for 2010–2016)



Source: own calculations. Month no. 1 = June, 2010; month no. 79 = December, 2016.

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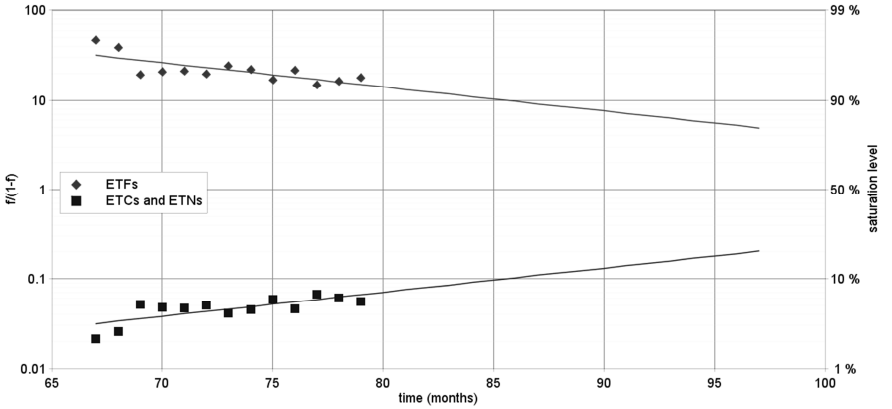
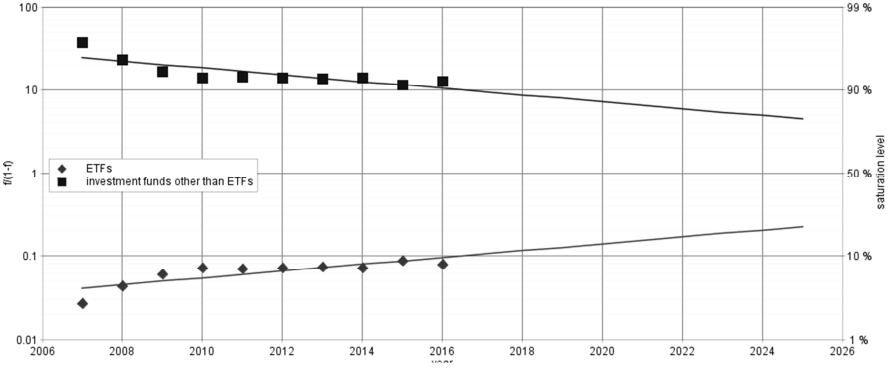
Figure 6. Exchange-traded products observed and predicted substitution patterns in Germany. December, 2015 — June, 2018



Source: own elaboration in the IIASA LSM2 software (logistic-fit, Fisher-Pry transformation).

Figure 7. Investment funds observed and predicted substitution patterns in Germany. 2007–2025



Source: own elaboration in the IIASA LSM2 software (logistic-fit, Fisher-Pry transformation).

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