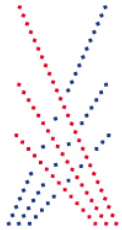

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Does Imitation Pay Off?
An Analysis of Imitations in a Less Developed Economy

Henrique Machado Barros
FEI University
hbarros@fei.edu.br

Marcio de Paula
Department for International Trade, UK
marcio.depaula@fco.gov.uk

Abstract:

Innovation has been systematically studied in academia. Yet, little is known about the effects of firms' imitative behaviour. Although the recent academic literature has become more interested in this phenomenon, the power of imitation has been largely underestimated. This is particularly relevant because much of the value created by innovators is captured by imitators. This paper seeks to advance our knowledge about imitation by analysing the market performance of imitations of 86 technologies developed in the pharmaceutical sector and introduced up to 52 years after the entry of their corresponding innovation. Based on estimations of 4-year panel probit models, this study examines how imitation's time of entry influences its performance (vis-à-vis innovation) and whether the nature of the imitation has any impact on imitation performance. Our findings confirm that late entry impairs the market performance of imitations, but that this effect also depends on the nature of imitations.

Keywords: Imitation; time of entry; performance; pharmaceuticals; credence goods

Track 9: Innovation

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1. Introduction

Innovation is often treated as pivotal for the survival of organizations, and it is commonly expected to have a positive effect on firms' performance (Cohen 2006; Rivkin 2000). Innovators, for example, can ensure leadership in technology development, maximize economic benefit, create loyalty, and influence consumer behaviour (Vidal & Mitchell 2013). In addition, when innovators erect barriers to entry, they can sustain their differences longer and thus achieve greater returns on innovative effort (Henderson & Cockburn 1996).

However, the success (or experience) of pioneers encourages other organizations to follow them (Markides & Sosa 2013). Not unsurprisingly, Nordhaus (2004) claims that almost 98% of the value of innovations is captured by imitators, making imitation a more valuable "business" than innovation itself (Shenkar 2010). Thus, it is common to observe companies with either less ambitious innovation strategies or deliberate strategies of imitation. This is all the more likely if innovators are in a position of weaker appropriability regimes or if they do not have the complementary assets needed by their businesses (Teece 1986). But the power of imitation is sometimes underestimated (Posen et al. 2013), and only recently has the management literature become interested in studying this phenomenon more closely (Lieberman & Asaba 2006).

According to Lieberman and Asaba (2006), when firms copy the attributes of the pioneer, they come to resemble the leading firm and this is not enough to generate competitive advantage. Therefore, imitators would achieve at most competitive parity. Posen et al. (2013) also argue that imitation may not be as simple as it seems; there may be imperfections in mimicking the innovator's concepts and expertise that make the imitation process more arduous. On the other hand, the authors recognize that the imitative behaviour of firms can assume attributes neglected by their peers and at times transform these attributes into rare and difficult to imitate assets, positioning the imitative firm in the frontier of performance previously assumed by the innovative company. Occasionally, this allows the mimic firm to achieve and even exceed the performance of the innovative firm. Thus, while pure imitation is harder to compete with innovation, when imitation involves some differentiation in its attributes or positioning, it is more likely to either improve the performance of imitative firms or position them ahead of their innovative counterparts.

However, it is well documented in the literature that the time of entry influences the performance of latecomers. In particular, the very late entry of an imitation makes its diffusion proportionally more difficult as the pioneer's service/ product can already enjoy recognition from the target audience just as the pioneer may already have access to the complementary assets that the imitator will not be able to have. In fact, the existing evidence confirms that the follower's delay in entering the market negatively affects its performance (Ethiraj & Zhu 2008). But little is known whether the nature of imitation (i.e., identical/pure or differentiated) has any impact on the effect of entry time on imitation performance.

Given that an identical (i.e., pure) imitation can actually compromise market performance (Lee & Zhou 2012), understanding the effect of the moment of launching imitations more comprehensively is a gap still to be filled. This is even more relevant in the context of less developed countries, such as Brazil, where firms are more likely to struggle to come up with new offerings novel to the world. That is, in less developed countries imitation may be more realistic and more frequent due to both the limited technological capabilities of local firms (Cerulli 2014) and the fragility of property rights in these countries (Barros 2015). Thus, this work aims to evaluate the effect of the moment of entry of the imitation, with or without differentiation, in its market performance. For this, the present work uses data of the Brazilian pharmaceutical sector. The analysis is based on a panel with the market performance

of 86 technologies embedded in oral products for cardiology in the period of 4 years, generating a total of 3284 observations, whose innovations were introduced in the Brazilian market up to 52 years before the imitations.

The next section presents our research hypotheses. Then, we briefly describe the Brazilian pharmaceutical market. Soon after, the methodological aspects are addressed so that the following section presents the analysis of the results. Finally, conclusions are drawn.

2. Literature Review and Research Hypotheses

Innovation has become understood as a virtue in the vocabulary of modern society (Godin 2015). In fact, strategy and innovation literatures have long documented the potential benefits of firms pursuing a creative endeavour (e.g., Zahra & Covin 1993). Thus, it is not surprising that many see imitation as an unappreciated behaviour (Posen et al. 2013). Whereas innovation has been at the centre stage of the management literature, our knowledge as to the outcomes of firms' mimetic conduct is still scant (Ethiraj & Zhu 2008; Lee and Zhou 2012). This is somewhat striking since, according to Nordhaus (2004), knowledge generators are only able to capture around two percent of the total social surplus from innovation. At best, imitation has been claimed as a threat that justifies scholars' effort to uncover firms' appropriability behaviour (Ceccagnoli 2009). It was only recently that the empirical literature started to directly uncover this phenomenon (e.g., Ethiraj & Zhu 2008; Posen et al. 2013). One stream of the literature has put effort to unveil the dynamics of imitation (and its performance consequences) on the basis of computational simulation (e.g., Rivkin 2000; Csaszar & Siggelkow 2010; Posen et al. 2013). Another line of research has attempted to empirically uncover the performance effects of imitation on the basis of secondary and/or primary data (e.g., Barreto & Baden-Fuller 2006; Ethiraj & Zhu 2008; Lee & Zhou 2012); we follow the latter.

According to Lieberman and Asaba (2006), there are two main theoretical perspectives that explain organizational imitation. The first perspective is information-based theory, which postulates that firms follow others when they are perceived as having superior information. The second is the rivalry theory which holds that firms imitate other firms to maintain competitive parity or to limit rivalry between them. Yet, to a large extent our knowledge about firms' imitative behaviour rests on the assessment of their creative counterpart – i.e., pioneers (Gomez, et al. 2015). The literature on first mover advantages has suggested that pioneers pre-empt late movers by both quickly establishing themselves in the marketplace and keeping pace with technology developments (Garcia-Sanchez et al. 2014). While this bulk of knowledge calls attention for the challenges of late movers in surpassing first movers, it does not fully account for imitators' behaviour since late comers enter existing market by supplying innovations as well as imitations. The stream of the literature that has directly assessed imitation has shown that this behaviour may be particularly detrimental if imitators follow innovators that make unattractive choices (Barreto & Baden-Fuller 2006). This bulk of knowledge, however, says little about the effects of different mimetic approaches.

Ethiraj and Zhu (2008) took a step further by relaxing the assumption that imitation is uniform. They noticed that differentiated imitation affects early entry advantages. In particular, they found that by delaying imitation late movers may compete on the basis of vertical differentiation, and this is more likely to make them beat the pioneer. However, the authors did not pay attention to a widespread form of imitation; namely, pure imitation (i.e., products identical to pioneers). Lee and Zhou (2012) compared pure to differentiated (creative) imitation and detected that pure imitation is less likely to help imitators beat innovators' sales. Nevertheless, the authors did not account for the entry timing of imitations. Moreover, their analyses excluded credence goods - i.e., products whose value are hard to be known with

certainty (Darby & Karni 1973). Thus, the purpose of this paper is to add to this emerging literature by examining whether entry timing and the nature of imitation matter in laggards' ability to surpass innovators in the market for credence goods.

2.1 Research Hypotheses

The quest for profits makes firms imitate each other in order to keep, at least, competitive parity. And firms less equipped with valuable information tend to follow those they perceive as possessors of superior information (Lieberman & Asaba 2006). Thus, imitation is inherently adhered to the competitive landscape. Yet, competitive advantage is usually ascribed to those who come first (Lieberman & Montgomery 2013). First movers may benefit from having created a new market (or submarket) in a number of ways. For instance, pioneers may present technology leadership, may pre-empt scarce resources, and may generate switching costs for costumers (Lieberman and Montgomery, 1988). First mover advantages derive not only from firms' superior resources and capabilities but also from firms' ability to reconfigure these resources/ capabilities into new ones so that late movers are kept away from appropriating pioneers' rent streams (Suarez & Lanzolla 2008).

To the extent that innovation has become understood as a virtue (Godin 2015), imitators suffer from customers' perception of the value of their imitations, especially pure (or almost pure) imitations. As a result, the market for imitation is likely to be smaller than the market for innovation, and hence imitators may struggle to present superior performance (Carpenter & Nakamoto 1989). And this disadvantage is even more pronounced when imitators do not possess complementary assets that enhance their competitiveness (Teece 1986).

Ethiraj and Zhu (2008), however, have shown that late movers can enjoy informational advantages that make them vertically differentiate their imitations, and hence beat the innovator. That is, the effects of late entry on market (share) performance are not always in line with the literature on first mover advantage. This seems consistent with markets abundant with highly skilled firms where imitation is likely to happen earlier (i.e., prior to patent termination), and hence pioneers are not able to fully capitalize on their reputation. Yet we suspect that in less economically developed countries, where imitators lag behind technologically advanced innovators (Hawk et al. 2013), imitation takes place later (i.e., after innovators' patents expire) and, hence, the negative effects of late entry are likely to be pronounced.

As time goes by, imitators come across higher barriers to entry. Pioneers, for instance, may be well ahead in the learning curve and/or may have crystallized their sources of competitive advantage (e.g., unique resources, access to complementary assets, reputation) that are hard to overcome (Klepper 1996; Mitchel 1991). Thus, the longer it takes for an imitator to enter the market, the more challenging it becomes to catch up. Not surprisingly, anecdotal evidence of the pharmaceutical industry indicates that early followers achieve better performance than late followers. Schmid and Smith (2002), for example, observed that immediate entrants had higher sales spikes than late entrants. Thus, there are performance differences relating to the time of entry of imitations, so that we hypothesize that in less developed economies:

> *Hypothesis 1: The longer the imitation time lag, the lower the likelihood that the imitation will beat the innovation in sales.*

In turn, according to Rivkin (2000), differentiated imitations bring attributes that are missing in the original innovation. And these new features are likely to impact on the imitation performance, regardless of the entry timing. Shankar, Carpenter, and Lashman (1998), for instance, have detected that differentiated imitators were those who leapfrogged pioneers. The

evidence, therefore, seems to suggest that the way for an imitator to overcome the innovator is through differentiation and that multiple imitator inputs over time would fragment the overall market and reduce the likelihood of new entrants beating the innovator. Ethiraj and Zhu (2008) have gone further and have shown imitators beat innovators when the former pursue a vertical differentiation strategy. Thereby, it is more challenging for imitators to surpass innovators when customers appreciate (horizontal) variability in the product offering (Bohlmannet al. 2002).

But vertically differentiated imitation is less likely to happen in less developed economies. In these business settings firms' technological capabilities tend to be limited (Hawk et al. 2013) and intellectual property rights are more fragile (Barros 2015). In addition, customers' purchase power is more constrained in these markets. Vertically differentiated imitation poses extra costs in its development (as compared to pure imitation) that make them less affordable. Also, products with differentiations tend to have the most time-consuming adoption by the consumer. Consumers require a greater promotion effort to understand the added benefits and functionalities before adopting such products. As a result, pure or almost pure (i.e., horizontally differentiated) imitation strategies are likely to prevail in less developed economies (Lee & Zhou 2012).

To the extent that imitation in less economically developed countries is likely to happen on average at later moments, accounting for the pure imitation strategy is critical. While Ethiraj and Zhu (2008) are silent as to the performance effects of pure imitation we follow Lee and Zhou (2012) and explore this research avenue. By contrasting pure imitation (i.e., identical to the original innovation) to almost pure imitation (i.e., nearly identical to the original innovation) we expect to unravel which imitation is most likely to beat the innovator (in sales).

Lee and Zhou (2012) have identified that a pure imitation strategy negatively affects the market performance of imitative firms. Their work, however, consists of a single-period analysis (i.e., cross-section) and may not capture the real effects of the pure imitation strategy on performance. In addition, they provide evidence for industries with shorter product life cycles and that are not characterized by credence goods. We, in turn, test a potential boundary condition and assess the impact of different imitation strategies in an empirical setting characterized by longer product life cycles as well as goods whose quality depends on experts' opinion (Dulleck & Kerschbamer 2006). Therefore, to the extent that pure imitations present face validity (i.e., have been attested by experts as equivalents to the innovation) they are more likely to present informational advantage and hence to meet consumers' expectation more easily. Thus, *ceteris paribus*, we formulate the hypothesis that in less developed economies imitations of innovations with longer product life cycles and whose quality depends on experts' opinion:

> *Hypothesis 2: The closer the imitation is to the original innovation, the higher the likelihood that the imitation will beat the innovation in sales.*

In the market for search goods, a pure imitation strategy is more successful when imitators are equipped with superior marketing capabilities (Lee & Zhou 2012). Somehow, these capabilities are likely to drive firms' time of entry that would ultimately condition their imitation strategy. In a way, these superior marketing skills may qualify imitative firms to enter the market earlier because they identify opportunities to imitate them earlier. That is, firms that enter the market later will continue to have more difficulty in competing. In fact, Ethiraj and Zhu (2008) also identified that product differentiation mediates the impact of imitator's entry timing on the likelihood of beating the innovator, and this explains why the negative effect of imitation lag is not noticeable in their research. We claim, however, that in less developed economies a vertically differentiated imitation strategy is barely an option. Firms follow either

a pure or almost pure imitation strategy, which are not particularly conditioned on the timing of entry. Imitation strategies are pursued as a result of the underlying costs (Caliari & Ruiz 2014) and the lack of superior innovative capabilities (Cerulli 2014). In addition, we contend that in the market for credence goods (as opposed to search goods), imitation tends to occur after a patent expires, and hence imitations' time of entry is unlikely to be a result of firms' marketing capabilities.

Whereas a pure imitation is identical to the original innovation in technical features, and hence well known by consumers and experts, an almost pure imitation lacks (or has not confirmed) some technical features that could make customers perceive the latter as a substitute for the original innovation. Therefore, the effort of imitators to trade almost pure imitations resides in showing to experts (and regulatory bodies, when needed) how close their imitations are to the original innovations. That is, a pure imitation of a credence good is likely to be more demanded than an almost pure imitation because experts' opinion are formed on the basis of imitators' effort to (technically) show how close their imitations are to the original innovation. As a pure imitation ascribes the imitation a closer similarity to the innovation, and this favours customers' choice in the market for credence goods, we argue that the effects on performance of the moment imitations arrive in the marketplace are interfered with the nature of the imitation. By opting for a strategy that mimics the benefits offered by the innovator at a lower cost to the consumer, imitators will be able to at least mitigate the difficulties imposed by a later entry. And pure imitations, due to their informational advantage over almost pure imitations, are more likely to mitigate the deleterious effect that a late entry imposes on the performance of imitative firms. Thus, we postulate that for imitations of innovations with longer product life cycles and whose quality depends on experts' opinion:

> *Hypothesis 3: The nature of the imitation moderates the effects of the imitation time lag on sales performance so that a pure imitation attenuates more (than an almost pure imitation) the negative impact of a longer imitation time lag on the likelihood that the imitation will beat the innovation in sales.*

3. The Brazilian Pharmaceutical Market

After a long period of low innovation productivity, high Research & Development (R&D) costs, rising regulatory barriers and not long ago global economic crisis, it has become central for the global pharmaceutical industry to recover its profitability. In a scenario of uncertainties and financial constraints, firms have sought to adopt strategies for portfolio diversification, portfolio/ firm buying, and competing in emerging markets. This does not mean, however, that innovation is no longer a factor generating competitive advantage in this sector. For example, about $550 billion has been invested by the world's big pharma companies in R&D over the past decade (PhRMA, 2018). However, while the most radical innovations depend on R&D effort, companies do not only act on radical innovations; there is also room for incremental innovations and imitations with or without differentiation (Geisendorf 2009). With the high costs and risks inherent in radical innovation, regulatory barriers, competition for new markets, and pressures for more affordable prices, the path of imitation has become a natural choice for smaller firms or technology. Not even the major pharmaceutical multinationals have prioritized the launch of new drugs in the Brazilian market. As a result, imitation has been a common behaviour in this market (Falavigna et al. 2013).

In Brazil, the retail pharmaceutical market recently reached R$ 35 billion in sales, discounted prices, up 13.5% over the same period last year. This amount can be considered even more significant when it is known that the pharmaceutical retail market in Brazil presents as a peculiarity a high volume of discounts on the official price (also known as 'list price').

These discounts are negotiated between firms and distributors/ wholesalers and, subsequently, between wholesalers/ distributors and points of sale/ retailers (Bueno et al. 2013). Brazil is expected to consolidate soon as the fourth largest pharmaceutical market in the world, behind only the United States, China and Japan (Falavigna et al. 2013).

However, Brazilian consumers of pharmaceutical products are very price sensitive. In order to serve a portion of these consumers who cannot afford the costs of drug therapy, the federal government of Brazil implemented a public policy in 2004 (the 'Popular Pharmacy Program of Brazil'), which provides 90% discount for the final consumer (Bueno et al. 2013). More recently, in 2011, the Brazilian government instituted the 'Priceless Health Program', which exempts specific medications for hypertension and diabetes at pharmacies that are part of the program (Falavigna et al. 2013).

The products traded in the pharmaceutical industry are characterized by, among other things, being credential goods, that is, consumers have difficulty evaluating the quality of the product and depend on a qualified agent to help them make that evaluation (Darby & Karni 1973). In an attempt to incentivise the development of an indigenous industry the Brazilian Generic Drugs Act of 1999 allowed firms to launch copies of pharmaceutical drugs (whose patents were already expired) that would not go through tests of bioequivalence to the reference drugs (i.e., no need to be therapeutically equivalent and to have the same bioavailability). This so-called ‘similar drug’ has to meet only the bioavailability criterion (i.e., the speed and the extent of absorption of the active principle). Instead, a ‘generic drug’ has to meet both criteria, and hence is an imitation that is closer to the pioneer drug than is a ‘similar drug’. It is also compulsory for the ‘similar drug’ to take a brand name whereas the generic drug is identified by both the active principle and a special label provided by the Ministry of Health. In addition, while the generic drug can replace the reference medicine prescribed by the doctor, the similar drug cannot. So, legal penalties apply if pharmacists dispense a ‘similar drug’ (instead of a generic drug) in substitution for the reference drug (Caliari & Ruiz 2014; Pinto & Barreiro 2013). Thus, it can be said that the generic drug is a 'pure imitation' and the similar drug is an ‘almost pure imitation’, whose attributes make it horizontally differentiated from the reference drug (Dubey & Dubey 2009).

4. Research Method

4.1 Data

Our dataset comes from the cardiovascular segment of the Brazilian pharmaceutical industry, and was provided by an international reputable consulting firm in the area (i.e., IQVIA, former IMS Health). We ended up with around 3284 observations encompassing 86 technologies from 9 therapeutic classes. We chose the pharmaceutical industry for a number of reasons. Firstly, this industry is well known for its high Research and Development (R&D) effort (DiMasi et al. 1991) as well as the risks associated with it (Grabowski and Vernon 1990). According to the Pharmaceutical Research and Manufacturers of America’s (PhRMA, 2018), its member companies invested around USD 71 billion in R&D in 2018. Secondly, pharmaceutical drugs are typically credence goods since their quality is hard to be assessed by ordinary customers (Dulleck & Kerschbamer 2006). Finally, this an industry where innovators sooner or later have to compete against imitation (Salvo 2009). In addition, we picked the cardiovascular segment due to its representativeness in the Brazilian pharmaceutical market (Pinto & Barreiro 2013) as well as to customers’ potential sensitivity to changes in sources of treatment (Srivastava & Kumar 2014), reinforcing the credence goods feature of the imitations we were interested in.

From an initial sample, those observations that were administered by other routes, other than oral, such as ampoules and injectable solutions, creams, ointments, lotions, skin disks, suppositories, and others were withdrawn. We also depleted lab technologies whose revenues have reached zero or close to zero in some of the years of interest (2010-2013). Imitations whose release dates could not be determined as well as those that had no representative as a "reference" or at least one copy (similar or generic medicine) registered were also withdrawn. After these delimitations, the sample resulted in 86 technologies that were introduced by firms operating in the Brazilian market, whose innovations were imitated and information was available along the period of 2010 and 2013. This period was chosen mainly due to data access feasibility and the provision of a number of observations (3284) large enough for our analysis.

4.2 Variables

In order to study the phenomenon of interest, we estimated a model based on a number of variables encompassing information on the performance of the imitation, the time lag between the entry of the innovation and the entry of the imitation as well as the nature of the imitation. It follows below a description of the variables used in the estimation models and soon after we present the descriptive statistics of the variables (Table 1).

4.2.1 Response variable

- *Beat innovator* - For each year, we ranked all drugs within a therapeutic class by sales revenues. Each imitator drug for each year was coded one if its sales rank was higher than that of the innovator and coded zero if its sales rank was lower.

4.2.2 Explanatory variables

- *Imitation lag* - It was measured as the time difference in years between the moment the reference drug (i.e., innovation) was introduced in the market and the time of entry in the market of the imitation drug (either 'pure' or 'almost pure').
- *Imitation* - This is a dummy variable that took the value of one for the 'pure imitation' (i.e., generic drug) and the value of zero for the 'almost pure imitation' (i.e., similar drug).

4.2.3 Control variables

- *Ownership* - This is a dummy variable that was coded one when the firm was domestically controlled. Then, it was coded zero when the firm was foreign controlled.
- *Firm size* - Computed as an imitator's total sales revenue for each year (R$ Millions).
- *Government Policy 1* - This is a dummy variable that was coded one when the purchase of the imitation was subsidized by a Government Policy known as 'Popular Pharmacy Program' (*Programa Farmacia Popular do Brasil*). And zero otherwise.
- *Government Policy 2* - This is a dummy variable that was coded one when the purchase of the imitation was subsidized by a Government Policy known as 'Priceless Health Program' (*Programa Saude Nao Tem Preco*). And zero otherwise.
- *Year dummies* - These are binary variables coded one when the information pertained to a particular year, and zero otherwise.

- *Therapeutic class dummies* - These are binary variables coded one when the information pertained to a particular therapeutic class, and zero otherwise.

Table 1 – Descriptive statistics

	Beat innovator	*Imitation lag*	*Imitation*	*Ownership*	*Firm size (R$ Millions)*	*Policy 1*	*Policy 2*
Medium	0.5460	17.7235	0.3764	0.6790	4.7841	0.1413	0.2147
Std deviation	0.4980	10.5193	0.4845	0.4669	5.9906	0.3484	0.4107
Minimum	0	0	0	0	1	0	0
Maximum	1	52	1	1	21.7998	1	1

4.3 Econometrics Framework

In the present work, the model dependent variable is binary, and is coded zero (0) when the imitation sales does not surpass the innovation sales in a given year and one (1) when the imitation sales beat, in a given year, the innovation sales. For each technology there are observations for 4 years. Considering the binary nature of the dependent variable and the longitudinal feature of the data, we opted to use a binary panel response model. Therefore, probit models were employed to determine the likelihood of a type of imitation surpassing the innovation in sales volume in a given year.

Given the choice of the model, it was necessary to define whether the intrinsic effect on individuals and time invariant (characteristic of panel models) would be random or fixed. In the case of random effects, as it is part of the error, this effect cannot be correlated with any of the explanatory variables of the model. Already, in random effects, this hypothesis of strict exogeneity is not necessary. It is known, however, that it is not possible to consistently estimate a probit model assuming fixed effects. The random effect is more efficient than the fixed effect on the hypothesis of strict exogeneity as is the case of the hypotheses assumed in this work. The random effects model is estimated using quadrature, which is an approximation that depends partly on the number of integration points used. A quadrature test was performed to determine how many points would be required for the final result of the estimation to be robust. The output showed that with 20 integration points, the relative difference in relation to 14 and 26 points is in most cases less or close to 1%. That is, the coefficients vary little between near integration points. Given that the variable of interest ('Imitation') does not change over time, we chose to use random effects, assuming the hypothesis of strict exogeneity.

5. Results

Figure 1 shows the average time lag between the launch of the innovation and the launch of the imitation. It is clear that for each imitation category (pure - PI or almost pure – API) imitations that beat innovations present on average a smaller delay to enter the market, and this pattern is consistent over time. It is also observed that the almost pure imitations have an average time of entry smaller than pure imitations in both cases in which the imitation surpasses and in the cases in which the imitation does not surpass the innovation. It is observed, therefore, that the time lag for the launch of imitations seems to influence the probability that they overcome their corresponding innovations (i.e., reference drug). An additional naive analysis (Figure 2) also indicates that pure imitations have surpassed innovations more than have almost pure imitations. This suggests that pure imitations present superior market (i.e., sales) performance as compared to almost pure imitations,

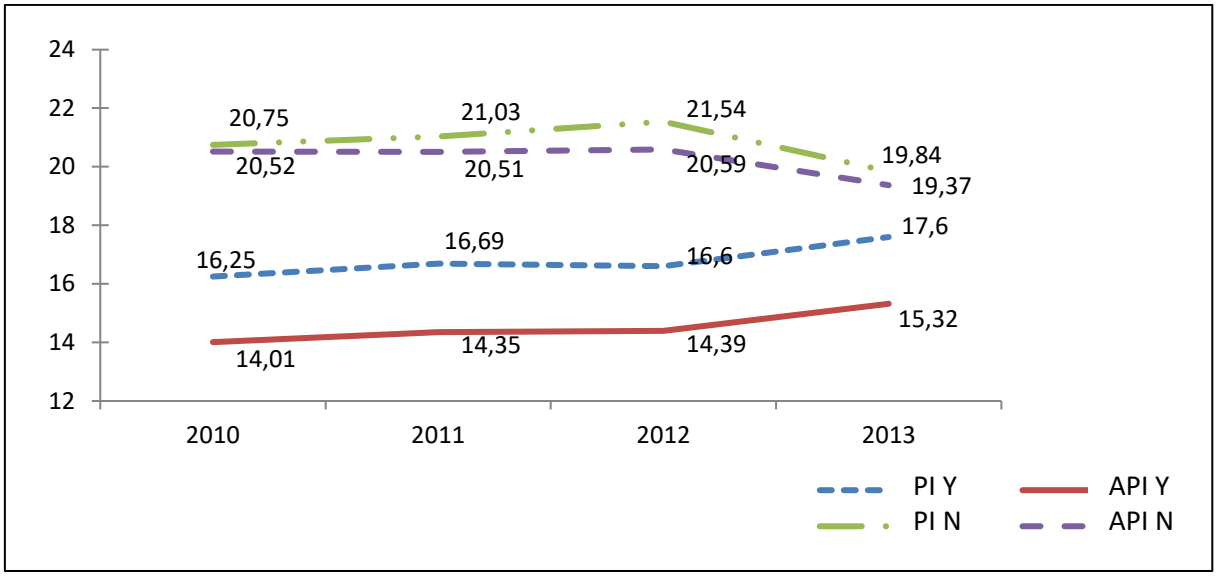

Figure 1. Average delay of launch of Pure Imitations (PI) and Almost Pure Imitations (API) that have (Y) or not (N) beaten their corresponding innovation.

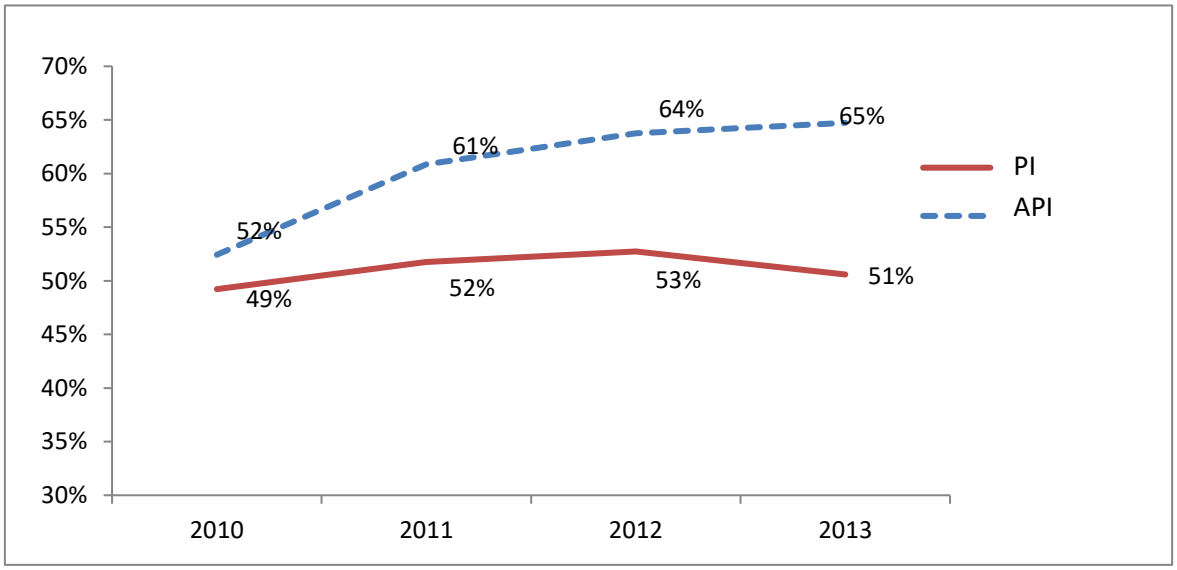

Figure 2. Percentage of pure imitations (PI) or almost pure imitations (API) that have beaten (in sales) their corresponding innovation over the years.

The figures shown above support hypotheses 1 and 2, demonstrating that the longer the time lag, the lower the probability that imitations overcome innovations, and also that pure imitations have a greater impact than almost pure imitations in relation to the probability of overcoming innovations. That is, the nature of imitation seems to have an impact on its market outcome. This reinforces our suspicion that the nature of imitation may interfere with the impact of the delay in market entry on market (sales) performance. However, this is just a preliminary analysis without a more rigorous analytical framework.

Table 2 – Probit estimates for probability of beating the innovation[a,b,c]

	Model **(1)**	***Model*** **(2)**	***Model*** **(3)**	***Model*** **(4)**	***Model*** **(5)**
Imitation Lag		-0.0337***		-0.0377***	-0.0529***
		(0.0128)		(0.0128)	(0.0161)
Imitation			0.423*	0.520**	-0.178
			(0.235)	(0.235)	(0.441)
Imit Lag x Imitation					0.0393*
					(0.221)
Ownership	-0.136	-0.0500	-0.0999	0.00526	0.00782
	(0.202)	(0.202)	(0.204)	(0.205)	(0.205)
Firm Size	0.0997***	0.0975***	0.0947***	0.0909***	0.0893***
	(0.0201)	(0.0199)	(0.0203)	(0.0200)	(0.0199)
Government Policy 1	-0.576**	-0.516**	-0.570**	-0.501**	-0.512**
	(0.235)	(0.236)	(0.235)	(0.237)	(0.237)
Government Policy 2	-0.805***	-0.729***	-0.797***	-0.709**	-0.722***
	(0.274)	(0.276)	(0.274)	(0.276)	(0.275)
Constant	1.426***	1.813***	1.289***	1.690***	1.973***
	(0.301)	(0.342)	(0.312)	(0.347)	(0.390)
Year dummies	Yes	Yes	Yes	Yes	Yes
Therapeutic class dummies	Yes	Yes	Yes	Yes	Yes
Log Sigma2 u	1.880***	1.857***	1.878***	1.851***	1.848***
	(0.132)	(0.132)	(0.132)	(0.133)	(0.133)
Log pseudolikelihood	-1386.59	-1382.53	-1384.63	-1379.95	-1378.20
Prob > chi2	0	0	0	0	0
No. id_tec	821	821	821	821	821
Obs	3284	3284	3284	3284	3284

[a] Robust standard errors in parentheses.
[b] *** p<0.01, ** p<0.05, * p<0.1
[c] Integration method: mvaghermite. Number of integration points: 20

Model 1 (Table 2) presents the results of a specification that includes only control variables. The signals of the controls are in the expected direction. For instance, larger imitative firms are more likely to outperform the innovator, which is consistent with the results of previous work (Ethiraj & Zhu 2008; Lee & Zhou 2012) and can be justified by the fact that they are likely to present complementary assets that favour the adoption of imitation. Imitations encompassed by government grant programs were less likely to overcome the innovation. This effect can be justified by the fact that when the physician becomes aware of the availability of certain technology in consumer subsidy programs, the physician prescribes the drug of his or her preference or trust, since the price factor would no longer interfere with the consumer/ patient choice. It is interesting perhaps that imitations' ability to overcome innovations does not depend on the ownership (i.e., foreign or domestic) of the imitator.

Model 2 includes the variable 'imitation lag', which is the time difference in years between the launch of the copycat and its innovation. The negative sign denotes that for each additional year of lag between the imitation and the innovation, the less likely the imitation will beat the innovator. This finding is consistent with previous research (Robinson & Fornell,; Urban et al. 1986) and with hypothesis 1 (the longer the imitation time lag, the lower the likelihood that the imitation will beat the innovation in sales). This effect is likely to be determined by the fragmentation of the market each year of waiting to launch the imitation, reducing the likelihood of new entrants to outperform the innovation. However, this finding

contradicts the previous findings by Ethiraj and Zhu (2008), who, when evaluating the imitation performance in the North American pharmaceutical market, found that the time lag increases the probability of the imitator overtaking the innovator. However, the authors used branded products (excluding generic ones) in an innovation-driven sector that represents almost half of the global pharmaceutical market. It is not surprising, therefore, that the average time lag found by the authors was 6.84 years, while it was 17.72 years in the present study.

Model 3 includes the 'imitation' variable in isolation, excluding the effect of the time lag. In this case, the estimation result for this variable suggests that a pure imitation may be more advantageous. But this is just a weak evidence in that model. In turn, Model 4, which is the full model, reinforces that the nature of imitation impacts imitations ability to surpass innovations. In particular, it shows that pure imitations are more likely to beat innovations. This finding contradicts the result obtained by Lee and Zhou (2012) who found that pure imitations obtained worse market performance than differentiated imitation. However, the authors evaluated sectors (i.e., electronics, information technology, telecommunications) whose product life cycles are shorter and the obsolescence is certain some years after the launch of an innovative product, besides not controlling the time of entry of the new products. Therefore, our findings do not allow one to reject hypothesis 2 that in less developed economies imitations of innovations with longer product life cycles and whose quality depends on experts' opinion the closer the imitation is to the original innovation, the higher the likelihood that the imitation will beat the innovation in sales.

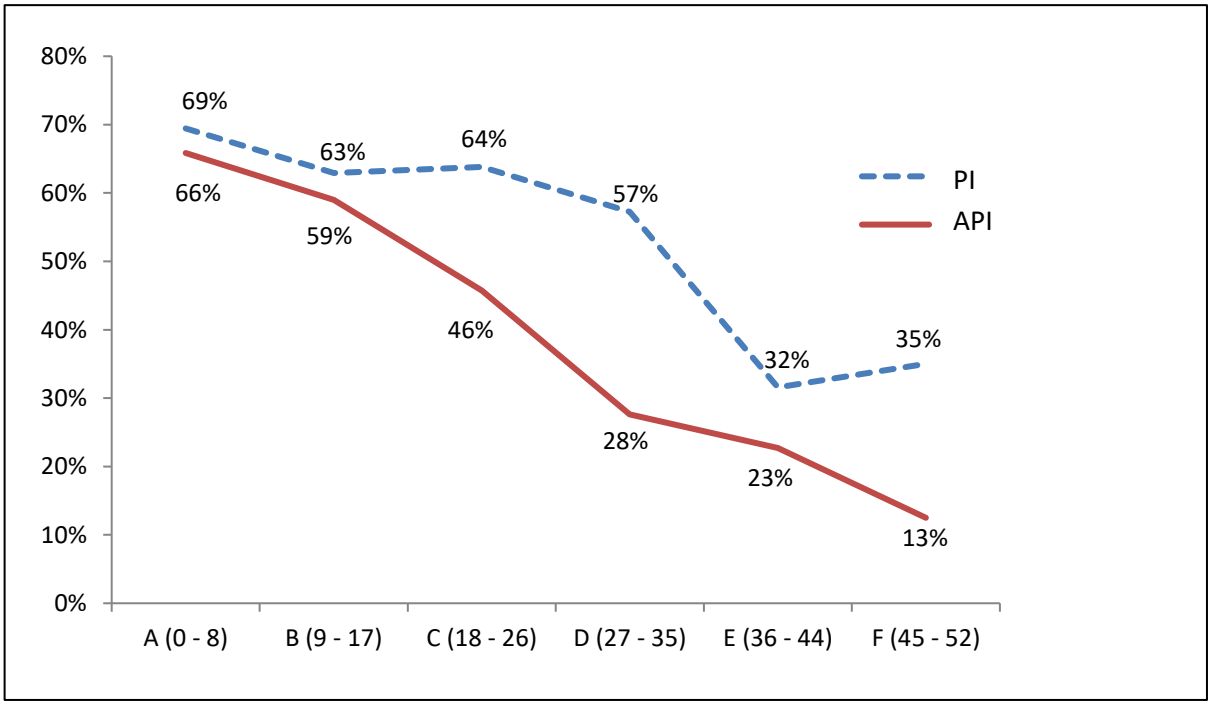

Figure 3 – Percentage of imitations that have overtaken the innovation (by time lag range in years) [a,b]
[a] Number of observations: A=592; B=1364; C=700; D=392; E=164; F=7.
[b] PI – Pure Imitation; API – Almost Pure Imitation.

Last, Model 5, which is the moderating model, does not (strongly) support the initial reasoning that the nature of imitation interfere with the impact of time lag on imitation performance. The weak statistical significance of the interaction term may be a result of multicollinearity, which is common in this type of model. Thus, hypothesis 3 still requires other evidence to be supported. We have then analysed whether there was any pattern in the percentage of imitations that have overtaken the innovation (Figure 3). This analysis has

revealed that the percentage of imitations that have overtaken the innovation decreases the longer an imitation enters the market, and that pure imitations suffer the action of time, as to its probability of overcoming the innovator, but retains some advantage over almost pure imitations. So, our overall results do not allow us to reject hypothesis 3 that for imitations of innovations with longer product life cycles and whose quality depends on experts' opinion the nature of the imitation moderates the effects of the imitation time lag on sales performance. In particular, pure imitations attenuate more (than almost pure imitations) the negative impact of a longer imitation time lag on the likelihood that the imitation beats the innovation in sales.

6. Conclusions

The purpose of this study was to evaluate the market behaviour of innovative and imitating products over a given period of time in order to identify what makes imitations surpass innovations. We used data from 86 oral technologies in the area of cardiology between 2010 and 2013, and our analysis was based on estimations of panel probit models of 3284 observations.

Our findings have shown that, at least for products with longer life cycles in less developed countries, innovations benefit from first mover advantages. Yet, pure imitation seems to enhance imitators' ability to leapfrog innovators in that context. In addition, albeit weak, our empirical exercise has suggested that the nature of imitation moderates the relationship between entry timing and the probability of beating the innovation. Even if the latter is not fully supported by our estimation endeavour, visual presentation of our data supplements our econometric effort indicating that the performance discount for late movers depends on their degree of similarity to their corresponding innovation.

Our research is among the few to empirically explore the (sales) performance effects of i) late movers' entry in product markets characterized by credence goods and ii) laggards' imitation nature. We can, therefore, derive a few theoretical implications from our analysis. For instance, in contrast to early findings our results indicate that the consequences of arriving late are context-specific. That is, the benefits of a head start are evident for products with longer life cycles that can somehow benefit from patent protection and to whose customers have difficulties in assessing the substitutability of imitative alternatives. Moreover, imitators' ability to surpass innovators also resorts to their imitation strategy, which can attenuate the discount imposed by a late arrival as well. In particular, our findings suggest that under information asymmetry (i.e., credence goods) the imitation strategy that is most likely to succeed is the one that mirrors as much as possible the innovation.

Managerial implications are straightforward: innovators in markets with information asymmetry should not underrate late entrants' ability to compete. Pioneers should better understand the effects of late movers' more likely to succeed strategy in order to craft their own strategy. As for imitators, their strategy to leapfrog pioneers should not overlook how late they are entering the competitive market. Last, when the demand side is sensitive to the reliability of the imitation and is not well equipped with information mechanisms the benefits of a pure imitation strategy seems to payoff

Among the limitations of this study, one can indicate its inability to show the effect of the imitation on the economic performance of the firms. Moreover, although the 4-year period of analysis is reasonable, it would be interesting to capture the behaviour of the imitators over a longer time range. Information such as the investments in R&D, the degree of differentiation of imitations and the number of patents ascribed to the innovation were also not available.

For future research it would be interesting to identify the effect of imitation in sectors where products have shorter life cycles, and the impact of differentiation is quickly felt. In the

pharmaceutical sector there are segments with such attributes, such as dermocosmetics and prescription drugs (anti-fluids, analgesics, antiseptics). In addition, it would be interesting to understand better how governmental programs of subsidies to the dispensation of drugs of continuous use (hypertension and diabetes, for example) influence the competitive dynamics between innovator and imitator. Finally, more research is needed to understand which factors influence the imitative behaviour in firms, especially in cases where firms compete on the basis of both innovation and imitation at the same time.

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