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The Drivers of Value Migration in the US Pharmaceutical Industry (1976-2010)

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Abstract
Value migration is an important phenomenon through which value shifts from one segment of an industry to another. Extant research has emphasized the role of agency of key firms called kingpins whose purposeful actions lead to changes and modifications in the template through which value is created and distributed in an industry sector. Using a large inter-firm transactions dataset on the US pharmaceutical industry for the period 1976-2010 combined with a rich historical account of the dynamics of this sector, we identify how three drivers (firm agency, and technological and regulatory change) work to support and constrain value creation and migration in this important sector of the US economy.

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Abstract

Value migration is an important phenomenon through which value shifts from one segment of an industry to another. Extant research has emphasized the role of agency of key firms called kingpins whose purposeful actions lead to changes and modifications in the template through which value is created and distributed in an industry sector. Using a large inter-firm transactions dataset on the US pharmaceutical industry for the period 1976-2010 combined with a rich historical account of the dynamics of this sector, we identify how three drivers (firm agency, and technological and regulatory change) work to support and constrain value creation and migration in this important sector of the US economy.

Keywords: value migration, industry evolution, kingpins, pharmaceutical industry
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I. Introduction

Value migration is the process through which value shifts from one segment to another in an industry or sector. Consider for example the computer industry and Intel (Jacobides and Tae, 2015): despite an increasing number of competitors, Intel managed to become the dominating force in its microprocessor segment and the overall computer sector. As firms constantly engage in strategic pursuits to capture larger shares of industry worth, value migration emerges as an important, but underexplored phenomenon in the evolution of industries. It is an activity that results in many incumbent firms losing out to smaller, nimbler firms. But how does this value migration happen? And how do some firms manage to appropriate value from larger more entrenched firms? These are the questions we examine in this paper.

Prior research on industry architecture provides explanations of the process of intra-industry value migration, focusing on value migration within the computer industry (Jacobides et al., 2006; Jacobides and Tae, 2015). The reason for this within industry focus is that it assumed that significant value migration largely only occurs between players within segments of the North American computer industry. Jacobides and Tae (2015) show that industry kingpins, firms which are the most important in a segment in terms of value, can disproportionately and in a double-edge way impact the structure of the industry. On the one hand a kingpin firm within a segment leads to better value for the segment within the industry. Yet at the same time, as kingpins grow more powerful over time, value migrates not just to the segment but directly to the kingpin at the expense of smaller firms, leading to greater inequality.
We build on and add to these studies by assuming value migration is more than just a series of transactions between vertically linked firms in a single industry sector. Instead, we consider that smaller, nimbler fringe firms can capture value and grow rapidly through linkages with firms in other industries. By fringe firms we mean firms which have a lesser share of value in the segment and the sector. In other words, we examine inter-industry value migration, as sectors are becoming increasingly dynamic and interdependent (Adner, 2012). There is also a staggering variety of inter-industry networks of firms in the economy (Dhanaraj and Parkhe, 2006). We examine how such networks allow smaller firms to form and use linkages with firms in other industries to establish sources of revenues which enable them to grow rapidly without being completely constrained by the “rules of the game” enforced by the entrenched kingpins. As these small firms grow through inter-industry transactions unhindered by the larger, more established firms, they have an opportunity to use their increasing power to realign the industry architecture to their advantage.

Using a novel dataset of inter-firm transactions over a 25 year period (1976-2010), we examine inter-industry value migration by the pharmaceutical industry in the United States. With most studies using the existing NAICS codes to identify industries and industry sectors, there is the possibility that they are not capturing the actual structure of the economy (Dalziel, 2007). Inter-firm transactions data can offer a much better perspective by highlighting the flow of value through actual transactions between industry sectors. In doing so we emphasize the following contributions: first, by expanding the analysis of value migration from within sector to across industry sectors we highlight the prevalence and importance of inter-industry linkages in value migration. Second, we identify the conditions under which fringe firms can survive, succeed and emerge as potential kingpins. Third, by using a novel longitudinal inter-firm transactions dataset,
we highlight the potential of such datasets to ameliorate some of the challenges associated with extant approaches understand the structure of the economy.

II. Theoretical Background

The Evolution and Architecture of Industries

The industry evolution literature has devoted considerable attention to firm entry and exit (Audretsch, 1995), product and process innovation (Abernathy and Utterback, 1978), lifecycles and markets (Klepper, 1996 & 1997) and technological change (Nelson and Winter, 1982; Nelson, 1994). Though the creation and capture of value is inherent in these processes, limited attention has been paid to the process of value migration from one segment of the sector to another. More specifically, firms which are able to create and capture value survive in an industry. They may do this through product and process innovation or through a better understanding of the product and industry lifecycles.

In response to the lack of focus of the industry evolution literature on the patterns of division of profit or value, more recent work has examining the process of value migration in different industries. By analyzing aggregate data, these studies examine the impact of leading firms or kingpins in articulating or modifying the template for value creation (Teece, 1986; Jacobides et al., 2006; Jacobides and Tae, 2015) or value capture in a sector (Pisano and Teece, 2007). Implicit in this stream of research is the role of agency of key firms who are able to set templates to further entrench their value capture capabilities. They may do this by trying to become bottlenecks (Baldwin, 2015) forcing other firms in their segment to follow their lead. Yet, a challenge with this view is that some industries may be highly regulated which offer
protection for incumbents but also exogenously create shocks or opportunities which may impact the value creation and migration process. Thus, value migration is partly explained by the agency of leading firms, and partly by factors beyond the control of firms in the sector. For instance, it is argued industries have “velocity regimes” where the rate and direction of change in demand, technology, completion, regulation and product innovation, can all interact and combine to define the dynamics and structure of an industry (McCarthy et al. 2010).

Sectors are increasingly becoming dynamic and interdependent (Adner, 2012) and researchers have examined innovation adoption or success in these interdependent sectors or value chains (Kapoor and Adner, 2012). This interdependence and value creation has also been studied using concepts like ecosystems (Iansiti and Levien; 2004), platforms (Gawer and Cusumano, 2002 & 2008) and industry architecture (Teece, 1986; Jacobides et al., 2006; Jacobides and Tae, 2015). Yet some important and interesting questions remain: What enables or constrains changes in industry architecture? How do parties initiate change or react to it? Incumbents have generally been portrayed as being resistant to change (Hannan and Freeman, 1984), but may at times launch initiatives building on exogenous technological advances. Such initiatives might at times involve cooperation with other members of the value chain in the search for more value creation (Jacobides et al., 2015).

The role of regulations and resource scarcity in enabling or constraining value migration has been suggested (Jacobides et al., 2015) but further analysis is needed to understand how these factors operate in distinct industry contexts. The impact of system integration on value migration as a strategy followed by some firms needs further elaboration. We use the context of the US pharmaceutical industry to explore these issues further.
III. Hypothesis Development

Our general proposition is that inter-industry value migration plays an important role in shaping the evolution of an industry in several ways. In the following hypotheses, the “role” refers to the classification of the firms in the pharmaceutical sector into customer service providers, wholesalers and manufacturers by 4-digit NAICS codes (Table 1).

Leading firms in a sector may attract further value by investing in research and development which creates a virtuous cycle. As their products or services become better or their internal processes become more cost-effective, these leading firms are able to secure an increasing proportion value in their segment. This power then may be translated into efforts to seek dominance of the sector, by trying to make the segment a bottleneck.

**H1:** The greater the R&D expenditure of a kingpin, the higher the revenue share of the role.

One way in which firms may try to grow despite being constrained by larger more established incumbent firms, may be by finding buyers for their products and services in other sectors. Extant literature has shown that a robust network or ecosystem of firms can work to both generate and satisfy demand, and firms possessing skills and capabilities of value across industries may find it particularly useful to target buyers in other industries. This approach enables them to survive and grow while learning more about the challenges of a different sector. Once the environment becomes more conducive they may be able to choose a sector which matches their longer term strategy. Another benefit of this approach is the possibility that targeting buyers in another industry may kingpins to grow rapidly and develop the capability and the resources to engage more directly with the incumbents in their own sector. Thus, we argue
that a higher proportion of transactions with firms outside the sector may encourage higher revenue share for the role.

**H2:** The higher the proportion of transactions with firms outside the sector, the higher the revenue share of the role.

More specifically, it is also possible that firms may possess a better understanding of the capabilities and resources required to survive in a similar role in another industry. They may therefore be better able to target buyers in a similar role in another sector. Firms with capabilities which are broadly applicable across sectors can gain in such circumstances.

**H3:** The higher the proportion of transactions with firms in the same role, the higher the revenue share of the role.

**IV. Research Design**

We examine value migration in the pharmaceutical industry in the United States using inter-firm transactions data. We conduct fixed-effects panel data regression to assess the impact of kingpin firms and transactions with firms in others sectors on value migration in this sector. In order to provide further evidence of value migration we draw on rich descriptive accounts of the evolution of this sector from prior studies to further highlight the multiple drivers of value migration beyond the agency of leading firms.
Data

The data for this study is drawn from a large dataset containing over 53,000 inter-firm transactions conducted in the United States during 1976-2010. The US Securities and Exchange Commission (SEC) requires public firms to report transactions where sales to a specific customer exceed 10% of the total revenue of the seller. Some of these transactions are over US$20 billion and may be among the largest transactions in the US economy. This dataset thus provides a unique perspective of the actual flow of value between firms in the US pharmaceutical industry. The raw data was prepared for analysis by removing observations where the customer was a government, geographic region or a product market. A string-matching algorithm was used to match firms that that have multiple names, such as Ford International and FMC with Ford Motors, and missing NAICS codes were identified. Drawing on a system-based classification of sectors (Dalziel et al., 2015), we map 4-digit NAICS codes to hierarchically structured sector roles such as manufacturers, wholesalers and customer service providers (Fig. 1). Analyzing industry sectors by dividing them using such roles can shed light on the manner in which value migration occurs between vertically adjacent segments.

Dependent Variable

The dependent variable is the revenue share of role in the sector for each role year. We calculated roles’ total revenue by summing the revenues of the firms in each role for each role-year. This percentage contribution of this value to the sector revenue for the year was then calculated. We identified kingpins as the firms with the highest revenue.
Independent Variables

The independent variables we examined were the *Kingpin’s R&D expenditure* in a year, and the proportion of transactions with a different sector and the proportion of transactions with the same role. The Kingpin’s R&D expenditure was an indicator of the technological efforts of the leading firm in each role. As we had detailed transactions data between buyers and sellers, we were able to also examine the proportion of transactions within the pharmaceutical sector and transactions which were conducted with firms classified in other sectors. The classification of firms into distinct hierarchical roles also provides us the opportunity to investigate the prevalence and impact of horizontal transactions in this sector.

Control Variables

We used the mean of the R&D expenditure of firms in each role as a control. Additional controls to account for the size of the segment were the total number of firms in each role and the total number of employees in each role.

Methods

Given that many of our variables were ratios, we took natural logs (Aitchison, 1982). Most problems of unobserved heterogeneity in the panel data were handled through a fixed-effects specification. A hausman test confirmed the choice of a fixed-effects specification and VIF values were below 5.
V. Results

Our results (Table 3) suggest that R&D expenditure by kingpins may not lead to an increase in revenue share for the role. This suggests that there may be other drivers of value creation than R&D expenditure by kingpins. Jacobides et al. (2015) have shown that inequalities in R&D expenditure help kingpins to gain a growing share of their segments revenues which crowds out fringe firms within the segment. Further growth of the kingpins then leads to a larger share of value accruing to them helping them to set the segment up as a bottleneck. In the case of the pharmaceutical industry, the R&D expenditure of manufacturers, wholesalers or customer service providers does not seem to provide them a long term advantage in creating or sustaining a bottleneck. For pharmaceutical manufacturers, high levels of R&D may not necessarily lead to profits and growth. Pharmaceutical manufacturers have been facing a patent cliff for all their drugs going off-patent. Patents help the manufacturers protect their market share for a specified period of time. After this period as protection lapses, high levels of competition from generic drugs may rapidly reduce the profitability of blockbuster drugs. Successful new products have been harder to come by while costs have been rising continuously. With the onslaught of generic drugs profitability has been further reduced. This unique set of circumstances suggests that R&D expenditure by pharmaceutical manufacturers may not necessarily lead to higher levels of value capture. For pharmaceutical wholesalers, their investments in mega distribution centers and acquisitions of smaller weaker players for developing a wider geographical footprint, are of greater assistance in capturing value in this industry. The benefits from automation and information technology advances though significant have been quickly by both large and small wholesalers. For customer service providers or national chains and hospitals, investments in R&D also may not play a major role in value creation and capture. Thus, our result which shows
a small but significant negative impact of R&D expenditure of kingpins on revenue share of the role seems to indicate that higher levels of R&D expenditure may not sustain value creation in this sector.

Hypothesis 2, which proposed that a higher proportion of transactions with firms outside the pharmaceutical sector may lead a higher revenue share of the role, finds support in the data. In the context of this sector, manufacturers and wholesalers have been trying to distribute their products through a number of channels and this has varied over the decades. Manufacturers initially used to supply to hospitals directly but this has reduced drastically. Wholesalers by virtue of their ability to source, combine and distribute nationally have been able to establish their dominance.

Hypothesis 3 has also been supported by the data which shows that transactions with firms in a similar role has helped increase the revenue share of the role. This particularly true for wholesalers who may sell to each other in areas where they may not have geographic coverage themselves. This is again a factor which would be true in the context of the pharmaceutical industry where distribution is setup by geographical regions and agreements among buyers and sellers may provide for exclusivity which leaves the option of cooperation or acquisition to serve a new market.

VI. The Origin and Evolution of the US Pharmaceutical Industry: Results From Prior Studies

The US pharmaceutical industry originated in the mid-1700s with practitioners prescribing and providing medicines to the population (Fein, 1998). By the late 1800s, associations had emerged
for wholesalers who imported products from Europe and sold them across the US. As the potential customer base increased rapidly, there were nearly 59,000 drugstores by 1929 (Fein, 1998). The first national drug wholesaler McKesson, was formed in 1929 and by 1947 had hired a marketing professor from Ohio State who went on consolidate the buying operations at McKesson (Fein, 1998). With rapid growth in the 1950s and 60s, McKesson’s annual revenues in 1961 were over $400 million, indicative of its position in this industry sector (Fein, 1998). The passage of the Medicare and the Medicaid bills in 1965 added further impetus to the growth of this booming sector. Other drug wholesalers such as the Bergen Brunswig Drug company were also growing rapidly and by 1978 there were 147 drug wholesalers operating in the USA (Fein, 1998).

As has been the case in numerous sectors, this period of rapid growth was followed by two decades of consolidation through exits, mergers and acquisitions. By the end of 1995 only 53 wholesalers survived (Fein, 1998). Some wholesalers had grown rapidly through the acquisition of others, and by 1995, over 80% of pharmaceutical sales in the USA were handled by wholesalers, with direct sales by manufacturers accounting for less than 15% (Fein, 1998). This data is indicative of the quantum and direction of the migration of value from pharmaceutical manufacturers to wholesalers’ during 1940 to 1990. Another strategy used by wholesalers during this period was to sell some of their products to large non-medical retail chains which provided them another avenue to grow and raise further funds to be reinvested in technology, distribution assets and acquisitions.

The large national pharmaceutical wholesalers followed several innovative strategies to attract the interest of smaller regional players. Some firms offered their expertise in legal, marketing, accounting and operations domains so that the smaller firms could concentrate on
making and selling their products (Fein, 1998). Others used the technological advances in information technology to reduce costs and increase the efficiency of their operations and also provided several value-added services. The incumbent McKesson was facing increasing competition and their principal customers who were independent pharmacies were losing out to larger national chains. McKesson wanted to maintain the structure of their market and developed an electronic order entry system which enabled their customers to compete better with the larger retail chains (Clemons and Row, 1988). This was an unusual response at the time and even McKesson had not realized the disruption and internal challenges in the national rollout of this innovative technology. Other wholesalers who realized the potential of this technology to reduced costs followed suit. Wholesalers used the electronic data interchange to integrate more closely with the manufacturers as well as with their hospital and retail chain buyers (Oswald and Boulton, 1995). In this manner, they emerged as system integrators who invested in technology and mega-distribution centers to provide a wide assortment of products nationally to their customers. However, with consolidation among the buyers, wholesalers were forced to reduce their margins and thus limits were imposed on the amount of value they could capture in this sector.

In summary, pharmaceutical wholesalers benefited from regulations which spurred demand and adopted technologies which enabled them to lower their cost of operations and provide additional value-added services to their customers. With customers facing high switching costs, and pharmaceutical manufacturers unable to provide at low cost the wide assortment of products needed by buyer nationally, value started migrating from manufacturers to wholesalers. In this manner, value migration in this sector was driven both by exogenous as well as endogenous factors.
VII. Discussion

In this article, we explored how inter-industry transactions determine value migration in the US pharmaceutical industry (Fig. 2). Our study highlights the origin of consolidation among pharmaceutical wholesalers in the United States to multiple technological innovations adopted by incumbents, which were rapidly adopted by some younger firms which highlights that the adoption of technology by the pharmaceutical wholesalers did not have a high barrier to adoption.

In contrast to the industry evolution literature which suggests that the early stages of the evolution of an industry are the most fluid and later stages are characterized by established codes of conduct, we find that pharmaceutical industry in United States was impacted by exogenous factors such regulations which led to the introduction of Medicare and Medicaid which in turn lead to a significant increase in the demand for healthcare products.

Another important point which serves to temper the role of agency and constrain the value migration to leading firms in the US pharmaceutical wholesaling industry was the response of their buyers to aggregate their demand into larger groups to maintain their buying power and control the limits to which wholesalers could charge their customers.

An important perspective which emerged from the analysis of the transactions data was the strategy of the latecomer wholesalers to supply products to other industries, which enabled them to maintain profitability while trying increase the value captured within the pharmaceutical industry. This point is particularly important because it demonstrates how latecomer firms were able to leverage their distribution capabilities to satisfy the requirements of another industry
while maintaining the option of engaging more closely with the pharmaceutical industry once they were able to acquire other companies and develop a national footprint.

One question that needs to be addressed is “why did pharmaceutical manufacturers cede their earlier market dominance?”. They had been directly supplying their products but were forced to rely more and more on the wholesalers due to the increasingly important role of the wholesalers as system integrators. Systems integration is increasingly being recognized as a core capability (Hobday et al., 2005; Jacobides et al., 2015) which can play an important role in value creation and capture.

In summary, multiple exogenous factors such as favourable legislation and information technology advances helped increase demand while also reducing costs. As wholesalers started making higher profits, they used these funds to grow rapidly through acquisitions to expand their geographic footprint. They were also able to use their growing distribution skills to service firms in other industry sectors leading to more avenues for profits. On the demand front, as large customers demanded a bundle of products, available nationally at lower costs, the pharmaceutical wholesalers emerged as the intermediaries who were able to satisfy these requirements to the detriment of the pharmaceutical manufacturers. By integrating their electronic processing systems with the pharmaceutical manufacturers as well as the large hospital chains, the wholesalers were able to provide their value-added services at the lowest costs thus emerging as the favoured national sources for pharmaceutical products and services. Their continuous investments in mega-distribution centers and rapid acquisition of smaller regional wholesalers furthered erected barriers and ensured value migration from the pharmaceutical manufacturers to the wholesalers.
VIII. Limitations

This study combines granular transactions data collected on the US pharmaceutical industry during 1976-2010. Combining the insights drawn from the analysis of this dataset with rich descriptive accounts of the history of this industry, we are able to provide a nuanced perspective of the factors driving value migration from manufacturers to wholesalers in the US.

The results of this study are limited to the US pharmaceutical industry and may not be generalizable to other sectors. The transactions data we use are drawn from US Securities and Exchange Commission filings which require that publicly traded firms in the US disclose the percentage of their revenues attributable to a single customer if the revenue exceeds 10% of the total revenue of the seller. While these may be some of the most significant transactions in the US economy, for example transactions between Cardinal Health and Walgreens reached US$22 billion in 2009; we are unable to provide a complete picture of the rest of the transactions between firms in the US pharmaceutical industry. The nature of our dataset means that transactions with governments and non-profits are also excluded.

IX. Concluding Remarks

The process of value migration among firms and segments in an industry is driven by agency as well as by exogenous factors. Our study demonstrates that pharmaceutical wholesalers in the United States were able to grow rapidly by serving customers in other industries. Changes in the regulatory environment such as the launch of Medicare and Medicaid unleashed demand and led to further growth. Leading incumbent wholesalers were also at the forefront of the adoption of information technologies which helped them to reduce their cost of operations drastically. The
efforts of these early technology adopters was particularly targeted at becoming systems integrators who provided significant value added services both to the pharmaceutical manufacturers and to buyers. Beyond these factors, some incumbent and latecomer pharmaceutical wholesalers were able to grow rapidly through acquisitions which increased their geographic reach and enabled them to serve their customers nationally. The story is thus one of value migration through acquisitions, inter-firm transactions with firms in other sectors, and system integration using the windows of opportunity opened by regulatory changes and technological advances in information technology.
References


Fig. 1: The structure of the US Pharmaceutical Industry

Source: Oswald and Boulton (1995)

<table>
<thead>
<tr>
<th>Period</th>
<th>Customer Service Provider Revenue Share (%)</th>
<th>Wholesaler Revenue Share (%)</th>
<th>Manufacturer Revenue Share (%)</th>
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<tbody>
<tr>
<td>2006-2010</td>
<td>10.19</td>
<td>56.50</td>
<td>33.31</td>
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<tr>
<td>2001-2005</td>
<td>8.43</td>
<td>57.83</td>
<td>33.75</td>
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<td>1996-2000</td>
<td>6.59</td>
<td>32.92</td>
<td>60.49</td>
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<tr>
<td>1991-1995</td>
<td>18.33</td>
<td>27.83</td>
<td>53.84</td>
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<tr>
<td>1986-1990</td>
<td>30.90</td>
<td>19.06</td>
<td>50.04</td>
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<tr>
<td>1981-1985</td>
<td>13.67</td>
<td>85.88</td>
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<tr>
<td>1976-1980</td>
<td>16.77</td>
<td>19.92</td>
<td>81.31</td>
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Figure 2: Value Migration in the US Healthcare Industry (1976-2010)
<table>
<thead>
<tr>
<th>Sector</th>
<th>Customer Service Providers</th>
<th>Wholesalers</th>
<th>Manufacturers</th>
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<td>4242</td>
<td>3254, 3256, 3391</td>
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Table 2: Descriptive Statistics

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<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
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<td>1.686</td>
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<tr>
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<td>.336</td>
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<td>Prop_Same_Role</td>
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<td>.287</td>
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<tr>
<td>Role_RandD_Mean</td>
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<td>0.0091**</td>
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| N       | 92 | 76   |
| F       | 0.6148 | 5.8739 |
| P>F     | 0.6072 | 0.0001 |

* p<0.05; ** p<0.01; *** p<0.001