WHAT IS PROPELLING THE AMERICAN WORKER TO GO THE WAY OF THE HORSE?

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ABSTRACT

In today's increasingly dynamic global economy, many industrialized nations are developing comparative advantages that are derived from human effort rather than natural status in their export industries. This is evidenced by a global pattern of shifting man-made comparative advantages over time. Empirical evidence seems to lend support to Wassily Leontief's findings that would later contradict the previously accepted predictions of the factor endowment theory, which suggested that nations traded internationally based on their resource dispensations (Leontief, 1954). This study is a preliminary effort aimed at identifying meaningful factors that propel the development of human-based comparative advantages, and exploration of a testable theoretical framework that will aid a better understanding of the disposition of such factors for the United States exporting firms. Five intellectual property-intensive sectors are sampled. Primary findings indicate that the degree of economic freedom, patents enforcements and domestic lending rates may be important factors that help shape human-based advantages that lead to gains in export market share.

JEL: F1; L1; E0

KEY WORDS: exports, innovation, workforce anatomy, transformation, comparative advantage

INTRODUCTION

The utility of the horse during earlier times in human history is undeniable. Horses were used in service for man to ease burdensome tasks such as plowing fields and transportation, among several other practical uses. As society and economy evolved during the renaissance and industrial revolution periods, civilization became more advanced. Changes in society's interests and mechanism became inescapable. Horsemanship gradually transformed into an art form with the purpose of enhancing the horse's natural strength and beauty. Horses increasingly became specialized for artistic purposes as their use for practical ends was steadily replaced by Man's own growing usefulness to himself as he developed new mechanisms of accomplishing his work. Society's quest for improvement and advancement has been unrelenting throughout history. Human labor transition patterns that are comparable to those of the horse are evident around the world. The impact on the comparative advantages that nations hold is both dramatic and meaningful in international trade.

The findings of Leontief (Leontief, 1953), which are commonly referred to as "The Leontief Paradox" offer insights into the transformational changes that are unfolding in labor resources and the resulting influences on patterns of international trading among exporting nations. This study pays particular attention to United States (U.S.) export sector. In his study of U.S. export patterns, Leontief recognized that the U.S. seemed to have been endowed with more capital per worker than any other country in the world then. Thus, it was accepted that the US exports would have required more capital per worker than U.S. imports (Ohlin, 1933). However, Leontief's findings seemed to indicate a different outcome. U.S. imports were 30% more capital-intensive than U.S. exports. Subsequent investigations would reaffirm the findings (Leontief, 1956 and Robert Baldwin, 1971).

Leontief himself suggested an explanation for his own paradox. He argued that U.S. workers may be more efficient than foreign workers. Assuming that Countries around the world have identical

technologies, Leontief attributed the superior efficiency of American labor to superior economic organization and economic incentives. The U.S. workforce anatomy, similar to other advanced economies around the world, is trending in a steady shift in demand away from a less skilled toward a more skill-intensive workforce (Bound and Johnson, 1992; Katz and Murphy 1992). Remarkable technological advances are shaping the way production is accomplished. It follows that the level of skill that many jobs now require is technology based. While full obsolescent is doubtful, human labor independent of skills is becoming less useful compared to previous periods. Knowledge and skills are much more important in production today. This trend has produced dramatic changes in workforce anatomy and consequently comparative advantages held by nations. United States is among several advanced economies that are abundant in human capital (highly educated and trained workers) and export human capital intensive products.

The rest of the study proceeds with a review of literature, followed by an explanation and formulation of the model design, a discussion of data and analysis results, a statement of limitations and future research plans.

LITERATURE REVIEW

A Discussion of Explanatory Factors

If in fact the superiority of the U.S. workforce is the outcome of maturity in economic organization and growing incentives as suggested by Leontief and several more scholars, then it is granted that such status could be retained, improved, or lost, over time. Also then, the ability to achieve and retain a superior status would depend on the ability to affect the required and appropriate measures, and implement the needed economic policy actions. If the Leontief paradox sustains, it follows that the anatomy of the U.S. export industry workforce, and consequently export products will adjust to reflect changes in superiority status.

Considering the global environment in which trade is taking place, it is reasonable that dramatic changes occur in the demand for labor, especially in developed countries (Wood, 1994; Anderton and Brenton, 1999). For example, the demand for unskilled workers in the U.S. continues to decline. A similar trend is observed in other industrialized countries. This trend is expected to continue as employers of unskilled workers continue to face strong competition from other parts of the world, in particular, from the newly industrialized countries (NICs). The result is that greater skill is generated in the labor force.

Changes in production processes ultimately drive many of the trends that are observable in the labor forces across industries that are competing internationally. Most people will agree on the significant role of knowledge-based initiatives by firms. De la Mothe *et al* (2000) argue that this in itself is not a revolutionary insight. The idea of the impact of knowledge on processes and productivity dates back to Adam Smith's *Wealth of Nations* (1776), whose theory of the division of labor was essentially an economic and organizational theory of knowledge. Hulten (2000) points out that Marxian and neoclassical theories of growth also assign the greatest weight to productivity improvements driven by advances in the technology and organization of production. He adds that the New Growth Theory and the theory of capital and investment, another branch of neoclassical economics, both attach primary significance to the increase in investments in human capital, knowledge, and fixed capital. Knowledge accumulation may mean either new knowledge, greater access to existing knowledge, or a combination of both. These two components of knowledge contribute to changes in the way production is processed, and ultimately in the type of workers that are demanded (Schiff and Wang, 2000).

As an attribute, new knowledge is assumed to be value-adding. Such value originates from the human intellect which results from human ingenuity and inventiveness. Its orderly use, exchange or sharing

amongst various types of business partners in a complex network of strategic relationships that generally work harmoniously during the reorganization of production is what ultimately ends in improved processes and products in domestic and export markets. Therefore, we can assume that intellectual property is a reasonable indicator of knowledge dispensations. This form of thinking also lends itself to the well recognized ideas of Joseph Schumpeter.

Schumpeter (1949) wrote on *The Theory on Economic Development*, in which he emphasized the key role of entrepreneurship as an engine for development. While the focus of his work was the process of economic development, the ideas are applicable to processes that lead to change and development in industries. He recognized the dynamic nature of processes that drive change. He stated that capitalism is by nature, a form or method of economic change that can never be stationary. In his *Capitalism, Socialism, and Democracy,* Schumpeter (1976) argues that in order for development to occur, the capitalist engine must be kept in motion by the introduction of 'new combinations' (new consumer goods, new methods of production or transportation, new markets, new forms of industrial organization and so on) that a capitalist enterprise creates. The essence of development is a 'continuous disturbance' of the (economic) system through a process referred to as 'creative destruction.' This disturbance essentially takes the form of innovation, which, is a source of superior performance in firms. Reduction in competition can be realized when innovation allows a firm to significantly lower its costs, or differentiate its product (Aghion et. al 2001, 2005).

Nam Pham's (2010) study on intellectual property-intensive (IP intensive) industries in the U.S.—such as life sciences, software, and aerospace shows that IP-intensive industries succeed globally, drive innovation, and invest heavily in research and development. This, in turn, grows the economy by creating jobs and driving exports in a variety of different careers and trades, both blue collar and white collar (Pham, 2010). U.S. Census Bureau statistics indicate that over the period 2000-2008 approximately 60% of jobs in U.S. export industry were in IP-intensive industries, which are a type of human capital-intensive industry. The study also pointed out the role of IP-intensive industries in creation of new tradable products and services for the U.S. IP-intensive industries made up nearly half of output and sales of all 27 U.S. tradable industries and employed more than 30% of American workers in these industries. More important, IP-intensive industries accounted for approximately 60% of total U.S. exports—rising from $665 billion in 2000 to $910 billion in 2007. During this time period, American firms exported an annual average $405.5 billion of IP-intensive products versus $278.1 billion of non-IP-intensive products. Overall, while IP-intensive industries have not been immune from the unemployment trends since 2001, they also performed better than the non-IP intensive industries.

External Influencing Factors

The context in which firms are operating is momentous. This assertion coincides with what Leontief described as economic organization and incentives that constitute advantages that a nation may enjoy in the products and services it chooses to specialize in. Firms are organized, and compete in a given context which can be influenced by numerous factors. For instance, it cannot be taken for granted that patent protection in itself is a sufficient incentive for innovating firms. Several studies have shown that patent protection alone does not always confer consequential incentives (Levin et al, 1985; Hall and Ziedonis, 2001). It may be that the patent protection is weak for several reasons that originate outside the firm. This study will restrict itself to investigating such external factors that are deemed to be particularly meaningful.

In his attempt to answer the question question why a nation achieves international success in a particular industry, Michael Porter (1990) offers four broad attributes of a nation that shape the environment in which local firms compete. These attributes may either promote or impede the ability for firms to create a competitive advantage. Of particular interest in this study, is the role of conditions in the nation that

govern how firms are created, organized, and managed. His ideas stipulate that the home environment necessarily needs to be dynamic, challenging, and stimulating to firms to upgrade and increase their advantages over time. He points out that the more dynamic the national environment, the higher the likelihood of some firms failing (not all have equal skills and resources or ability to exploit the national environment equally well). It is those that make necessary changes to emerge from such an environment that will prosper in the international market.

Ezeala-Harrison's work on macroeconomic factors that influence competitiveness in firms presents a useful definition of the economy wide or contextual factors. He describes these as generally made up of supportive institutional arrangements and infrastructure facilities. Institutional factors include the variables of government policy actions. Examples are such as tax policy, labor market policy, exchange rate regime adopted, and financial sector regulatory or deregulatory policies, and the existence and adequacy of infrastructure. There also are the availability (or stability) of other institutional parameters such as legal, educational, health and para-medical, and financial infrastructure. The degree of "economic liberalization" provided and allowed by the country's authorities, and existence of adequate institutional framework in a country are crucial factors that influence innovative transformations in the export industries. These factors, however, hang largely on the political and (ideological) leaning of the country's authorities and policy makers. These policies usually remain fairly unchanged over time. These economy wide parameters are considered as qualitative in nature, in the sense that they are given (or constant) over time, and work to provide the ultimate background conditions in which individual firms can respond to incentives that are specific to the industries they occupy (Ezeala-Harrison, 2010).

Ezeala-Harrison elaborates on the meaning and significance of economic liberalization in trade: It is the package of measures designed to direct an economy away from restrictive regulatory and central control, toward a free-market based system which is based on competition, deregulation, and enhanced private-sector. Among the conceivably several major parameters of economic liberalization, two of the most cogent ones are the country's: (i) trade liberalization (or free trade) policy, and (ii) currency exchange rate regime (stable, flexible, and moderate exchange rate level). Other parameters of economic liberalization such as degree of privatization, deregulation, and centralization are equally important, and various indices could be employed to measure their levels to assess the degree of economic liberalization. These two are selected only on the basis of their being relatively easy to keep track of explicitly.
The impact of labor market trends in international trade around the world, and certainly for the U.S. is clear. For the U.S. most of the overall shift in U.S. labor demand in manufacturing since the early 1980s has a lot to do with change in skill demand from less skill-intensive to more skill-intensive as new knowledge is dispensed across industries. It is such transformations that render certain labor forms unnecessary over time, in a similar fashion to the horse as previously explained. Having made this recognition, this study seeks develop a conceptual framework that is useful in the understanding and investigation of organizational and incentive factors that are facilitating the necessary workforce transformations and resultant product changes in international trade.

METHODOLOGY

Model Design

The process through which exporting firms respond to national organizational advantages and incentives to develop dynamic abilities forms a part of the general features of the operational objective. To better understand the role and nature of the organizational advantages and industry incentives, it is necessary to examine the composite model of these processes. In this regard, this paper offers a simple model that can be applied to appropriate data. The model is envisaged to explore suitable specifications that would be ultimately helpful for determining policies towards a sustainable strong export performance.

Conceptually, two broad classifications of factors that influence the export industry workforce anatomy and export product type exist; namely, firm incentives and degree of economic organization. These coincide with industry-specific and economy wide realms respectively. Incentives for exporting firms can also be considered as factors that encourage innovative transformations within exporting firms and consequently in entire industries. Examples of these include profit or compensational gains, increased market share, spill over benefits and reputational benefits (Schmidt, 1997; Aghion et. al, 1999; Davis and Jerome, 2004), strength of copyright and patent legislation, degree of restrictiveness of industrial regulation, level of inter-industry rivalry (Sastry, 2005), strong industry-government research and development partnerships, and adaptability of the labor force. The external factors discussed in the literature review section constitute the context in which transformation takes place. Thus, the proposed model will necessarily seek to capture the influences of both firm incentives and environment context.

To reiterate, the determining factors that influence changes in the composition of the labor force and export product type can be broadly categorized as; existing incentives for exporting firms and the degree of economic organization of the country. Each category can be further decomposed into definitive variables that are specific to the export industry and those that involve the conditioning and supportive institutional arrangements and infrastructure. The basis for a testable formulation of the links between export industry innovative transformation and these determinant factors is a model that assumes similar capital endowments across countries (Leontief, 1953) and involves the level of labor utilization, and efficiency of allocation of resources. Competitive export firms will seek to effectively utilize resources in the most efficient manner relative to rival firms under conditions of equal capital endowment. Thus, a composite magnitude of total labor efficiency growth rate and product value changes over time constitutes the quantitative measure of export strength; it indicates the combined effect of the effectiveness of the firms resource utilization and resultant (export) product value (or product type).

The simplified mathematical depiction is as follows:

$$\text{Comp. } \{\Delta\alpha(K/L)/\Delta t + \Delta m/\Delta t\} = f(\sum_{k=0}^{n} \mu i\, X + \sum_{k=0}^{n} \beta i Z) \quad (1)$$

where,

- $\Delta\alpha$ = Change in the multiplicative factor that estimates the degree of relative worker skill level under the equal capital endowment assumption.
- K = Capital endowment measure
- L = Measure of Labor quantity
- Δm = Change in market share
- Δt = Change in time
- X = Firm incentives parameter
- Z = Organizational parameters
- i = Industry i
- β, μ = Weighting indexes of the degree of respective parameters

The combined development of worker skill set and innovation in the competitive exporting industry is thus shown as a function of the sum of incentives and organizational advantages that exist in that particular industry. This can be further simplified as follows:

$$\Delta\text{comp.}/\Delta t = \sum_{k=0}^{n} \mu i\, X + \sum_{k=0}^{n} \beta i Z \quad (2)$$

This simplistic model can be used to investigate how incentives and economic organizational advantages help shape changes in worker skill and innovation.

Data

The sample for the preliminary investigation was created by merging annual statistical data from multiple sources that include U.S government agencies and international sources such as the World Trade organization, World Intellectual Property Organization, the World Bank, and the United Nations Conference on Trade Development. The data represents pharmaceuticals, transportation equipment, chemicals, semiconductors, and communication equipment sectors of the U.S. economy. These sectors have been sampled previously because of their inclination for innovation (see Pham and Shapiro, 2007). Variable estimates include worker skill level, sector global market share, compensational benefits, corporate taxation rates, domestic lending rates, degree of economic freedom, government-industry research partnership, and dollar exchange rate against major global currencies, physical infrastructure, and patents enforcement. A lack of uniformity in data for all variables restricted the observations to the period 1997-2008.

A linear regression analysis was conducted on the organizational and firm-based incentives premised to impact the skill level and product market share composite index for each of the sampled sectors (see equation 2, and also equations in appendix section). Table 1 below is a summary of the analysis.

Table 1: Result Summary

Variable	Pharmaceutical	Communication Eq.	Semi Cond.	Transport. Eq.	Chemicals
(Constant)	-1.999	1.2019	-1,697,000,000	-0.3233	-1.1042
Compensational benefits					
Federal funds rate		*-1.8572	*-2,502,822	*1.5923	-1.2709
Gov. R & D expenditure				6.966	0.006
Degree of economic freedom	*-5.998	-1.6311	*2,907,579	0.0420	-2.6192
Corporate taxation	-2.264	-0.8205	-658,840	-0.1338	-0.3703
Dollar exchange rate index		*1.6524	*-1,921,277		
Physical Infrastructure	-0.5836			*6.2697	
Patents enforcement	0.3047	*181.99	-0.01407	* 0.0258	-0.232
Adjusted R-square	0.845	0.789	0.9	0.884	0.844
Durbin-Watson Statistics	2.185	3.725	3.268	2.094	2.471
F-statistic	9.746	14.118	7.172	12.445	31.133
P-value	0.045	0.012	0.04	0.032	0.003

This table shows the various variables analyzed for each sector and the various statistical outcomes. Missing data indicates that the associated variable was not tested for that sector. Variables that are discussed in the paper but failed to yield meaningful data are omitted from the table.
**Significant at 95 percent confidence level*

Discussion of Preliminary Results

The idea behind the analysis conducted in this study is to examine the influence of firm incentives and organizational advantages on the combined outcome of worker skill development and growth on product market share in the international market. The results are generally mixed, and do not offer robust outcomes that could lead to verifiable conclusions. Some possible reasons are discussed in the study limitations section to follow shortly. Nevertheless, preliminary findings give useful insights for future development of the study. In particular, domestic borrowing rates, dollar exchange rate against major global currencies, degree of economic freedom and patent enforcement are found to be significant variables in more than one of the sectors sampled. Strong financial markets that are accessible to innovators are understood as important factors for competing firms in any market (King and Levine, 1993; Levine, Loayza and Beck, 2000). It is also expected that economic freedom and strong patent enforcement will encourage valuable product innovation and skill acquisition in the market place. The dollar exchange rate is a fundamental variable given that trade takes place in a global context.

The R-square values were consistently high in all cases. Caution should be exercised when making conclusions about the of strength of relationship between the dependent and independent variables based

on the values. The unexpectedly high values suggest further investigation for multiciollinearity problems among the independent variables. Even though the overall P value is low, individual P values are not all low. A further analysis may identify variables that convey essentially the same information, which could either be eliminated from the analysis or combined with other variables. In addition, results of the communications equipment, semiconductors, and Chemical sector analysis returned high Durbin-Watson values, which may be indicative of autocorrelation problems with the data. The fit of the model for these sectors may need further exploration.

Statement of Limitations and Future Research

Although the study was carefully prepared, there were several unavoidable limitations that restricted its potential to adequately achieve the intended objective. Difficulties in data collection for made it difficult to gather complete datasets for some of the variables. As a result, the sample size was significantly reduced, and in some cases important variable replaced by alternative proxies that did not have a strong theoretical support. In addition, only two variables represented firm incentives in the model equation. Also, given the preliminary stage for this study, the approach was restricted to a significantly small sample of sectors that may be disproportionately skewed towards a limited set of industries. In reality, U.S exports to the rest of the world represent a much broader spectrum of industries. Finally, studies have pointed to some flaws in the Leontief paradox model, whose ideas this study borrows.

Future plans for this research will focus on addressing flaws that have been pointed out in the Leontief paradox in relation to the objectives of the study, and the careful gathering of complete sets of appropriate data. Substantial amount of time will be devoted to identifying key industries that are a good representation of United States exports sectors and the occupation types that dominate such sectors. With a more complete understanding of the determinant incentive and organizational factors that influence the United States export industry workforce and products, the study can offer policy prescriptions for sustainable and meaningful transformations. In a competitive global economy, workforce adaptability with shifting comparative advantages is widely recognized imperative.

APPENDIX

The actual equations that were used in the regression for the respective sectorial analysis are listed in this section. Readers should note that not all the proposed variables yielded sufficient data to allow for the conducting of a uniform set of analysis.

$$\text{Pharma } \Delta\text{comp.}/\Delta t = \sum\mu\text{patent} + \sum\beta_1\text{freedom} + \beta_2\text{tax} + \beta_3\text{finfrast} \quad (3)$$

$$\text{Comm. Equip } \Delta\text{comp.}/\Delta t = \sum\mu\text{patent} + \sum\beta_1\text{fed.fund} + \beta_2\text{freedom} + \beta_3\text{tax} + \beta_4\text{forex} \quad (4)$$

$$\text{Semicond. } \Delta\text{comp.}/\Delta t = \sum\mu\text{patent} + \sum\beta_1\text{fed.fund} + \beta_2\text{freedom} + \beta_3\text{tax} + \beta_4\text{forex} \quad (5)$$

$$\text{Tran.Equp. } \Delta\text{comp.}/\Delta t = \sum\mu\text{patent} + \sum\beta_1\text{fed.fund} + \beta_2\text{gov.R\&D} + \beta_3\text{freedom} + \beta_4\text{tax} + \beta_5\text{infrast} \quad (6)$$

$$\text{Chem. } \Delta\text{comp.}/\Delta t = \sum\mu\text{patent} + \sum\beta_1\text{fed.fund} + \beta_2\text{gov.R\&D} + \beta_3\text{freedom} + \beta_4\text{tax} \quad (7)$$

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