Testing Samuelson's Theorem on Factor Price Equalization in the Case of the United States

TACTOR PRICE EQUALIZATION THEOREM

(1) So long as there is partial specialization, with each country producing something of both goods, factor prices will be equalized, absolutely and relatively, by free international trade.
(2) Unless initial factor endowments are too unequal, commodity mobility will always be a perfect substitute for factor mobility.
(3) Regardless of initial factor endowment even if factors were mobile they would, at worst, have to migrate only up to a certain degree, after which commodity mobility would be sufficient for full price equalization.
(4) To the extent that commodity movements are effective substitutes for factor movements, world productivity is, in a certain sense, optimal; but at the same time, the imputed real returns of labor in one country and land in the other will necessarily be lower, not only relatively but also absolutely, than under autarky." (Paul Samuelson, 1948, "International Trade and Equalization of Factor Prices," *The Economic Journal*, Vol. 58, No. 230, Jun., 1948, pp. 163-184)

ASSUMPTIONS OF THE FACTOR PRICE EQUALIZATION THEOREM

In the classical two countries, two production factors, and two goods model the Factor Price Equalization Theorem is proved under the following eight assumptions:

(1) there are not barriers to trade;
(2) there are not transportation costs;
(3) there is perfect competition in each country and full employment before and after the elimination of trade barriers between the two countries;
(4) the production factors are mobile in each country but are immobile across national borders;
(5) there is not complete specialization as a result of free trade, both countries continue to produce the two goods;
(6) the production functions exhibit constant return to scale;
(7) the technologies in the two countries are identical; and
(8) there is not factor intensity reversal.

The Heckscher-Ohlin Theorem

A country will export those commodities which are produced with its relatively abundant factors of production, and will import those in the production of which its relatively scarce factors are important. And as a result of the shift towards increased production of those goods in which the abundant factors predominate there will be a tendency – necessarily incomplete – towards an equalization of factor prices between the two or more trading countries.
Under the assumption that the two factors are labor and capital, the theorem states:
The country better endowed with capital will export capital-intensive goods and import labor-intensive products, and the country better endowed with labor will export labor-intensive goods and import capital-intensive products.

The Stolper-Samuelson Theorem:

Under the assumptions of the Heckscher-Ohlin-Samuelson Model, an increase in the relative price of a good rises the return of the factor used intensively in the production of that good relative to all other prices and lowers the return to the other factor relative to all other prices.

The Rybczyinski Theorem:

An increase in a country's endowment of a factor will cause an increase in output of the good which uses that factor intensively, and a decrease in the output of the other good.

	Total Trde	Imports
2004	23.2	27.1
2005	25.5	26.8
2006	26.6	28.2
2007	26.7	30.9
2008	26.6	28.8
2009	30.3	33.5
2010	31.4	34.3
2011	31.2	33.6
2012	32	34.4
2013	31.4	35
2014	31.8	34.3
2015	33.6	35.7
2016	33.7	36.6
2017	34.2	40.7
2018	34	40.3
2019	34.2	39

Weight of Total Trade and Imports from Low Wage Countries in US Trade with its Main Trading Partners

	Country						
Year	China	Mexico	Brazil	India	Venezuela	Vietnam	Total
2019	13.5%	14.8%	1.8%	2.2%	-	1.9%	34.2%
2018	15.7%	14.5%	1.7%	2.1%	-	-	34.0%
2017	16.4%	14.3%	1.7%	1.8%	-	-	34.2%
2016	15.9%	14.4%	1.5%	1.9%	-	-	33.7%
2915	16.0%	14.2%	1.6%	1.8%	-	-	33.6%
2014	14.9%	13.5%	1.8%	1.7%	-	-	31.8%
2013	14.6%	13.2%	1.9%	1.7%	-	-	31.4%
2012	14.0%	12.9%	2.0%	1.6%	1.5%	-	32.0%
2011	13.6%	12.5%	2.0%	1.6%	1.5%	-	31.2%
2010	14.3%	12.3%	1.9%	1.5%	1.4%	-	31.4%
2009	14.0%	11.7%	1.8%	1.4%	1.4%	-	30.3%
2008	12.0%	10.8%	1.9%	-	1.9%	-	26.6%
2007	12.4%	11.1%	1.6%	-	1.6%	-	26.7%
2006	11.9%	11.5%	1.6%	-	1.6%	-	26.6%
2005	11.1%	11.3%	1.5%	-	1.6%	-	25.5%
2004	10.1%	11.6%	1.5%	-	-	-	23.2%

Author's calculations based on: data published in *US Census Bureau/Foreign Trade/Top Trading Partners*

Weight of U.S. Total Trade (Imports + Exports) with the Top Low Wage Trading Partners in the Whole U.S. Total Trade (Imports + Exports)

	Country								
Year	China	Mexico	Brazil	India	Venezuela	Nigeria	Vietnam	Malaysia	Total
2019	18.1%	14.3%	-	2.3%	-	-	2.7%	1.6%	39.0%
2018	21.2%	13.6%	-	2.1%	-	-	1.9%	1.5%	40.3%
2017	21.6%	13.4%	-	2.1%	-	-	2.0%	1.6%	40.7%
2016	21.1%	13.4%	-	2.1%	-	-	-	-	36.6%
2015	21.5%	12.2%	-	2.0%	-	-	-	-	35.7%
2014	19.9%	12.5%	-	1.9%	-	-	-	-	34.3%
2013	19.4%	12.4%	-	1.8%	1.4%	-	-	-	35.0%
2012	18.7%	12.2%	-	1.8%	1.7%	-	-	-	34.4%
2011	18.1%	11.9%	-	1.6%	2.0%	-	-	-	33.6%
2010	19.1%	12.0%	-	1.5%	1.7%	-	-	-	34.3 %
2009	19.0%	11.3%	-	1.4%	1.8%	-	-	-	33.5 %
2008	16.1%	10.3%	-	-	2.4%	-	-	-	28.8 %
2007	16.4%	10.8%	-	-	2.0%	1.7%	-	-	30.9%
2006	15.5%	10.7%	-	-	2.0%	-	-	-	28.2%
2005	14.6%	10.2%	-	-	2.0%	-	-	-	26.8 %
2004	13.4%	10.6%	1.4%	-	1.7%	-	-	-	27.1%

Author's calculations based on data published in *US Census Bureau/Foreign Trade/Top Trading Partners*

Weight of U.S. Imports from the Top Low Wage Trading Partners in the Whole U.S. Imports

Years	Nonfarm business sector	Manufacturing sector
1990 – 2000	2.2%	3.8%
2000 – 2007	2.7%	4.3%
2007 – 2019	1.3%	0.4%

Source: Bureau of Labor Statistics/ Office of Productivity and Technology

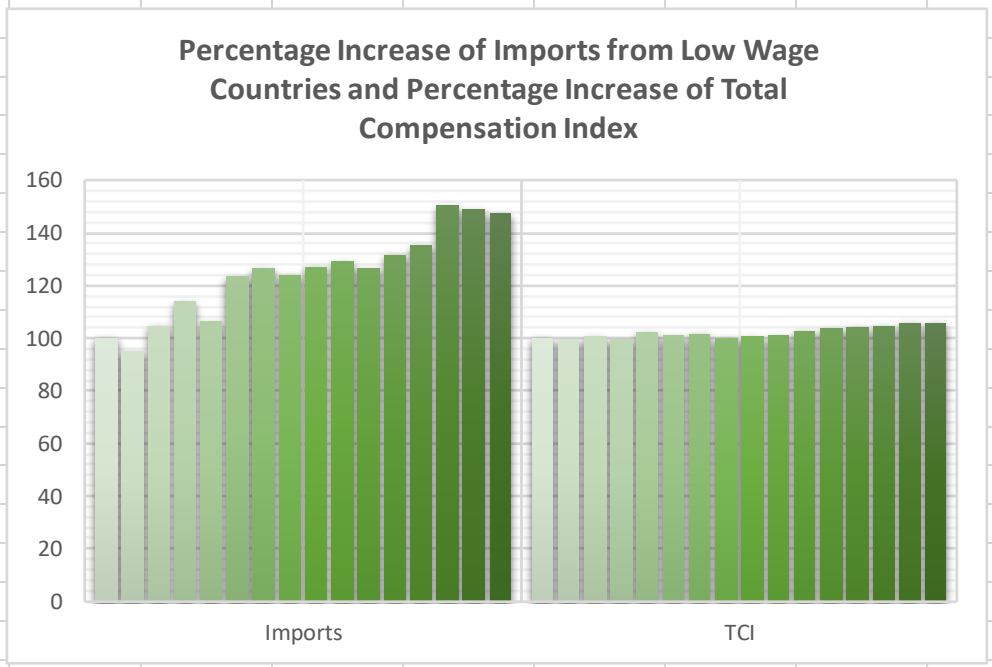
Productivity Indexes

Year	Weight of imports from low wage countries in total US imports	Total compensation index December 2005 = 100	Total compensation index December 2004 = 100	Labor productivity index	LPI - TCI
2019	39.0%	106.2	105.88	125.00	19.12
2018	40.3%	105.8	105.48	123.40	17.92
2017	40.7%	104.8	104.49	121.81	17.32
2016	36.6%	104.3	103.99	120.25	16.26
2015	35.7%	104.1	103.79	118.71	14.92
2014	34.3%	102.8	102.49	117.19	14.70
2013	35.0%	101.3	101.00	115.68	14.68
2012	34.4%	100.9	100.60	114.20	13.60
2011	33.6%	100.7	100.04	112.73	12.69
2010	34.3%	101.7	101.40	111.28	9.88
2009	33.5%	101.2	100.90	109.86	8.96
2008	28.8%	102.5	102.19	108.45	6.26
2007	30.9%	100.0	99.70	107.05	7.35
2006	28.2%	100.8	100.50	105.47	4.97
2005	25.8%	100.0	99.70	102.70	3.00
2004	27.1%	100.3	100.00	100.00	0.00

Author's calculations based on data published by the US Census Bureau and the Bureau of Labor Statistics

Differences Between Labor Productivity and Total Compensation Indexes

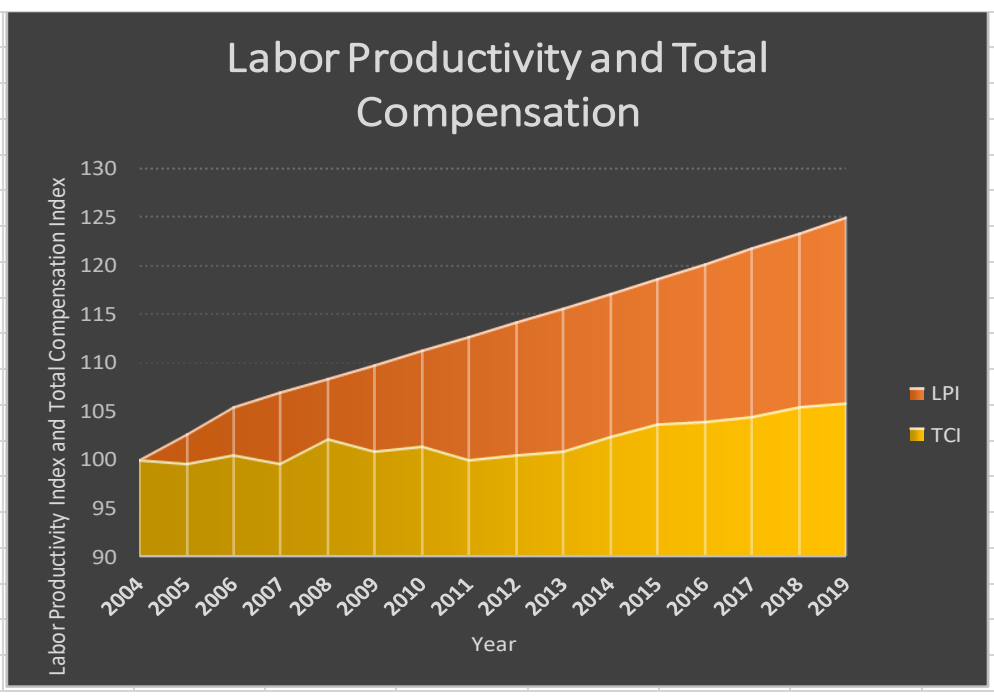
	Imports	TCI	% Imp
2004	100	100	27.1
2005	95.2	99.7	25.8
2006	104.6	100.5	28.2
2007	114	99.7	30.9
2008	106.3	102.19	28.8
2009	123.6	100.9	33.5
2010	126.6	101.4	34.3
2011	124	100.04	33.6
2012	126.9	100.6	34.4
2013	129.1	101	35
2014	126.6	102.49	34.3
2015	131.7	103.79	35.7
2016	135	103.99	36.6
2017	150.2	104.49	40.7
2018	148.7	105.48	40.3
2019	147.2	105.88	39.9



Imports from Low wage Countries Index and Total Compensation Index

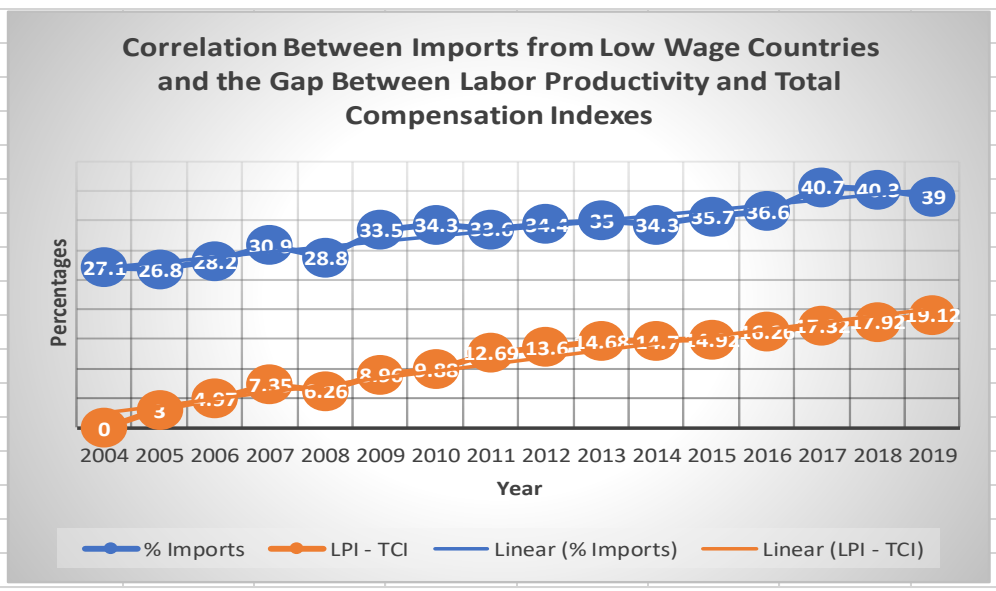
Conclusion 1: Samuelson's Theorem is empirically invalidated in the case of the United States because the important increase of trade with low wage countries has not diminished the total compensation, BUT…

	LPI	TCI
2004	100	100
2005	102.7	99.7
2006	105.47	100.5
2007	107.05	99.7
2008	108.45	102.19
2009	109.86	100.9
2010	111.28	101.4
2011	112.73	100.04
2012	114.2	100.6
2013	115.68	101
2014	117.19	102.49
2015	118.71	103.79
2016	120.25	103.99
2017	121.81	104.49
2018	123.4	105.48
2019	125	105.88



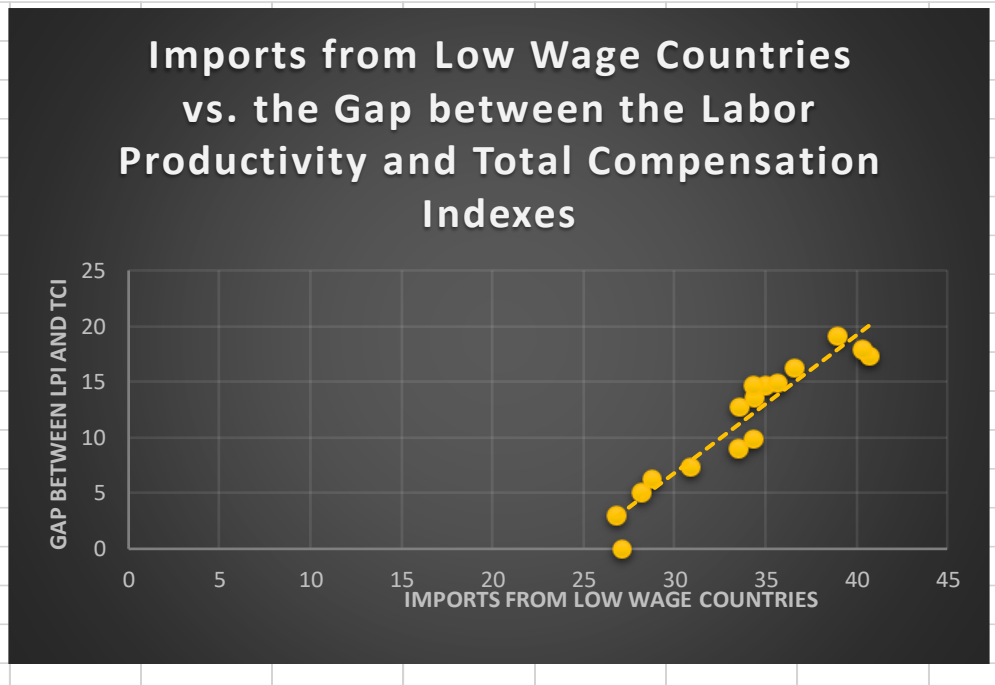
Conclusion 2: THE SIGNIFICANT INCREASE OF TRADE WITH LOW WAGE COUNTRIES PREVENTED THE INCREASE OF TOTAL COMPENSATION that would have normally been caused by the important increase in productivity.

	% Imports	LPI - TCI
2004	27.1	0
2005	26.8	3
2006	28.2	4.97
2007	30.9	7.35
2008	28.8	6.26
2009	33.5	8.96
2010	34.3	9.88
2011	33.6	12.69
2012	34.4	13.6
2013	35	14.68
2014	34.3	14.7
2015	35.7	14.92
2016	36.6	16.26
2017	40.7	17.32
2018	40.3	17.92
2019	39	19.12



Imports from Low Wage Countries Index and the Gap Between Labor Productivity and Total Compensation Indexes

	% Imports	LPI - TCI
2004	27.1	0
2005	26.8	3
2006	28.2	4.97
2007	30.9	7.35
2008	28.8	6.26
2009	33.5	8.96
2010	34.3	9.88
2011	33.6	12.69
2012	34.4	13.6
2013	35	14.68
2014	34.3	14.7
2015	35.7	14.92
2016	36.6	16.26
2017	40.7	17.32
2018	40.3	17.92
2019	39	19.12



Conclusion 3: **The Correlation Coefficient between the Weight of Imports from Low Wage Countries and the Gap between Labor Productivity and Total Compensation Indexes is 0.949.**

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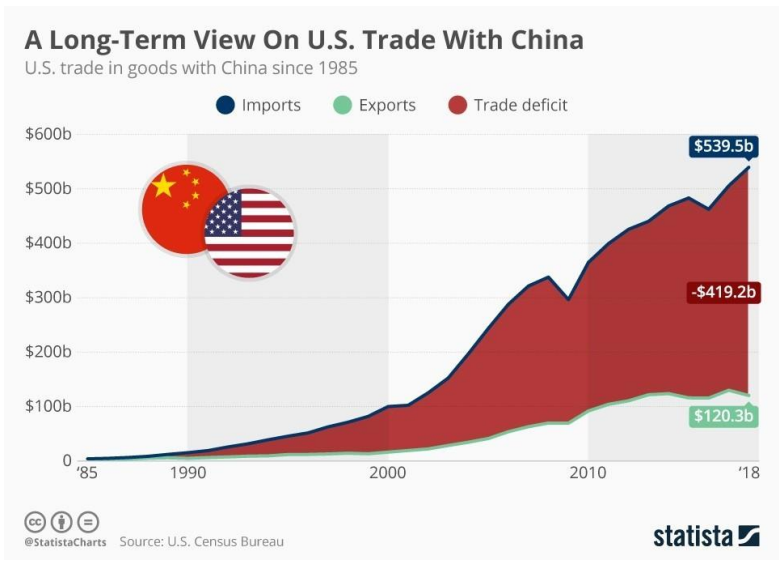
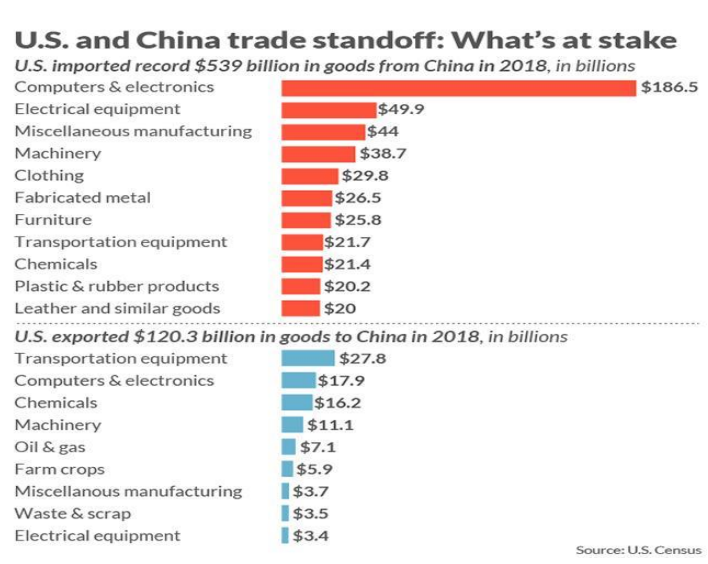
Derived Provocative Question:

In the 21th Century, will the United States Remain the World Leader in the Large-Scale Production of Capital Intensive, High Tech Industrial Goods?!

Analyzing the structure of the current US Trade with China the answer is not encouraging.



Source: US Census Bureau, infographic by StatistaCharts, www. Statista.com



Source: US Census Bureau, quoted in Jeffrey Bartash, Why the U.S.-China trade deficit is so huge: Here's all the stuff America imports, MarketWatch, June 27, 2019

Remarks

United States – China Trade in 2018:
(My calculations based on data published by US Census Bureau)

- **China exported to the United States 4.48 times more than imported**
- **The Total US Exports to China were 66.2 billion less than the US Imports of Computers and Electronics from China**
- **The US Imports of Electrical Equipment from China were 14.68 times larger than the US Exports of Electrical Equipment to China**
- **The US Imports of Machinery from China were 3.49 times larger than the US Exports of Machinery to China**
- **US Imports from China were 21% of Total US Imports**
- **US Exports to China were 7% of Total US Exports**