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Measuring the Deviations from Perfect Competition: International Evidence

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Abstract

We use aggregated macroeconomic data for 43 countries to test the microeconomic condition for Perfect Competition, whereby the price level is equal to the marginal cost in the long run. We postulate two forms of Perfect Competition in the macro data: a weaker-form and a stronger-form. The former exists if the price level and the marginal cost share a common long-run trend; i.e., cointegrated. The latter exists if the market price and the marginal cost are *equal* in the long run.

JEL Classifications
Keywords: Perfect Competition, price level, marginal cost, time series, cointgration, nonparametric. D01, D41, C12, C13, C22

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1. Introduction

Perfect Competition is an important theoretical microeconomic market structure of the firm, and the industry, whereby a large number of firms offer a homogeneous product. *Free entry* and exit of firms from the market and *perfect* information will allow for normal profits to be made while prices will be kept low by competitive pressures. Perfect Competition is characterized by (1) a market which consists of a large number of firms that produce homogeneous goods; (2) these firms freely enter and exit the market; (3) they have symmetric information about factor input prices and quantities, government policies, etc., and; (4) the firm is relatively small such that it is a price taker (exact opposite of the monopolistic firm).

Most governments care about competitiveness. In the United States, and many other Western capitalist economies, anti-trust laws are set up to make sure that monopolies and anti-competitive practices do not spread and dominate the economy. Ironically, many government regulations, fiscal, and monetary policies, trade barriers, and labor policies, could stand in the way of Perfect Competition. Imagine that goods and services tax (GST) or sales tax etc, whereby such taxes raise the market price and create a wedge between the price level and the marginal cost, hence nudging the markets away from equilibrium. Regulations could abstract free entry and exit from certain markets. And, labor policy could affect wages, hence costs. So, while governments care about competition on one side, they may inadvertently cause deviations from competitive equilibriums. Although policymakers may have some sense of competitiveness in the economy or industry, and in some cases they investigate certain noncompetitive behaviors; they do not have a readily available measure of the competitiveness of their economies.

It is straightforward to examine the competitiveness in an economy using Input-Output tables because the tables include data of prices and costs by firm and industry levels. However, these Tables are not available in many countries. As far as we are aware of, there is no macroeconomic measure, which could describe how competitive an economy is in order to inform the policymakers about the status of the economy over time.

The objective of this paper, therefore, is to confront macroeconomic data with the microeconomic theory of Perfect Competition. We test for Perfect Competition in more than forty countries using aggregate level macroeconomic data. We postulate two forms of Perfect Competition: a weaker-form and a stronger-form. A weaker-form of Perfect Competition exists if the price level and the marginal cost share a common long-run trend; i.e., cointegrated. We test the null hypothesis of "no cointegration" between the price level and the marginal cost. In other words, the price level is not equal to the marginal costs *per se* but when they are cointegarted. A stronger-form of Perfect Competition is one for *equality* between the market price and the marginal cost in the long run. In time series data, we do not expect every observation of the price level to be equal to every observation of the marginal cost, therefore, the larger the *relative* deviation, the less the competitiveness in that country is. Note that the equilibrium between the price level and the marginal cost is only theoretically consistent in the long run, i.e., not over the business cycle. For this reason we do not test for common cycles. When the price level and the marginal cost in any country pass the two tests of weak and strong forms of Perfect Competition, we deduce that there is evidence of Perfect Completion. If the data are only cointegrated we infer that there is evidence of a relatively weaker-form of Perfect Competition. And, when the data fail the two tests we conclude that the market is uncompetitive.

We use macroeconomic data for 42 countries representing the OECD, the EU, Australasia, the BRICS, Asia, and South America. We also tested Saudi Arabia because it is a major oil producer and as the second largest oil reserve in the world, which could be joining the BRICS. The countries are Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungry, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, U.K., U.S., China, Russia, Brazil, Indian, Saudi Arabia, South Africa, Hong Kong and Singapore. The sample consists of annual data from 1970 to 2022, except for some countries the time series are shorter. The data source for real GDP in local currencies is the OECD statistics and the Consumer Price Index for all items (CPI) is the Bank for International Settlements (BIS).

The results suggest that there is plenty of evidence that a weaker-form of Perfect Competition is present in macroeconomic data in almost all countries, i.e., the price level and the marginal costs are cointegrated. And, there is strong evidence that a stronger-form of Perfect competition also exists, i.e., the price level is *equal* to the marginal cost in the US, India, Germany and Estonia, which are the most competitive countries in the sample and a relatively less competitive 6 other countries: Australia, Austria, the Netherlands, Norway, Slovakia, and the EU-27. The policymaker could eyeball the data and see the deviations from Perfect Competition.

The next section presents a brief of the microeconomic theory of Perfect Competition in a production model. Section 3 presents the methodology and measurements. Section 4 is the time series tests of the trend of the price level and the marginal cost, and the long-run common trend, i.e. cointegration (Weaker-form of Perfect Competition). Section 5 is a test for the long-run equality of the price level and the marginal cost (stronger-form of Perfect Competition). Section 6 is a conclusion.

2. Microeconomic Theory

Theoretically, in a model of pure exchange market, there is a fixed total stock of a good. Consumers decide how many goods they want at some given price and use the market to either increase or decrease their stocks. There is equilibrium in the market when all consumers are able to make the net purchases or sales such that the consumer holds the desired stock of goods.

This analysis must add the production sector for completeness. However, such an addition is daunting and it is not a straightforward extension to the theory of pure exchange. Note that there is a crucial distinction to be made between stocks and flows. Production is a process of making a flow of goods over time. Therefore, the desired supply is also a flow. In a pure exchange model, the consumer desires to hold a stock of goods. The time element must be specified. One could think of the hour or the day as the smallest unit of time, hence production would be an hourly or a daily flow. In other words, there is a flow of goods demanded hourly or daily and there is a flow of goods supplied hourly or daily. The market would determine the price to clear to balance these two flows. There is another crucial issue in the case of production and that is the supplier makes continuous adjustments to the quantity of goods produced and there must be a time unit greater than an hour or day for such adjustment to be completed. This is crucial for the determination of the cost of the production and market adjustment. The producer must make such decisions. At the start of the period, at time $t = 0$, the producer chooses the quantity of goods to produce given information available at time $t = 0$ for the *current* price P, and fixed capacity. The producer also decides on the capacity and the output rate for the next period, $t = 1$, given forecasts (expectations) of market price. The time required is influenced by capacity adjustment - i.e. the time required to vary the quantity. This period is greater than an hour and a day in this case.

On day 1 of year 1, for example, the firm decides on the rate of output y, which was planned in the previous period. The firm finds out the price P when it sells the goods in the market. In the case that the price P is different from what was expected, the firm is unable to vary output in one day, therefore, the supply on day 1 year 1 is fixed. Output may vary on day 2, 3, and so on. If the market settles at a daily equilibrium, the firm will forecast the price of the next year, and plans its daily output and capacity for that year. In the theory of markets, the very short-run aspect is crucial for equilibrium. These short run adjustments are verified in Smith's work on experiments, see for example Smith (1962).

Assume that $x_i$denotes the ith consumer's rate of demand per day for the good and let the market demand be:

$$x = \sum_i x_i = \sum_i D_i(P) = D(p) \qquad (1)$$

where P is the market price. Assume that the demand adjusts to market prices and quantities within a day, i.e. there is no lengthy adjustment lags like the supply.
Let y_j be the daily rate of production, where $j$is the firm $j = 1, 2, \cdots m$

$$y_j = s_j(P) \qquad (2)$$

and

$y_j = S_j(P),$ (3)

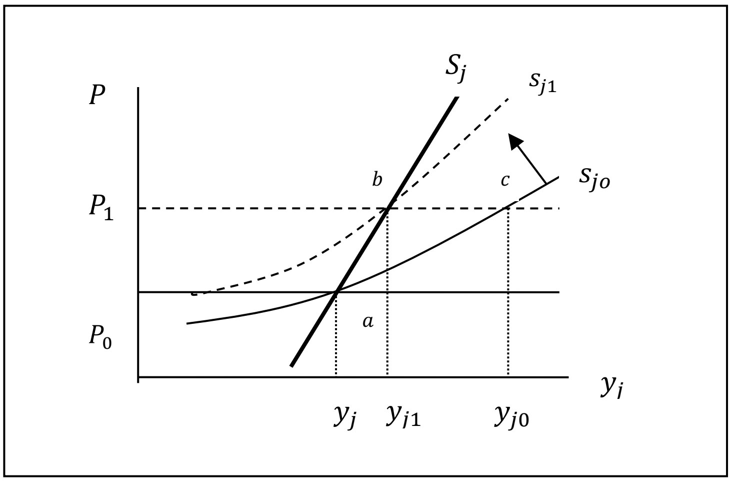
where (2) is the short-run supply and (3) is the long-run supply function.

As we explained earlier, the short-run supply $s_j$is subject to fixed capacity and the long-run supply S_j is not. There are m firms in year 0 and m'(equal, greater, or smaller) than m firms in year 1. It implies that under Perfect Competition, firms enter and exit in year 1.

The Short Run Supply

In Diagram (1), the price increases from P_0 to P_1. The firm's initial supply is the short-run marginal cost curve SMC is s_j. If the effect of expansions of all firms at the same time raises input prices, the marginal cost curve and the short-run supply curves of each firm in the industry must rise. Sketch (1) depicts a potential case of expansion of firms in response to the higher price. The short run supply curve has increased from $s_{j0}$to $s_{j1}$and hence the price is $P_1$and the firm will supply y_{j1}instead of y_{j0}. So when all firms expand, the points on the firm's supply curve corresponding to P_0 and $P_1$are points a and $b$respectively and $S_j$is the locus of all such price-supply pairs. The firm's effective market supply curve is $S_j$is less elastic than its $s_j$supply curve, everything else held constant. These two curves would be the same if (1) input prices do not increase by simultaneous expansion of output by all firms, and (2) there are no technological externalities. The market supply function is found by aggregating the *effective* supply functions $S_j(P)$, which are based on *actual* output adjustments rather than $s_j(P)$.

Diagram (1)
The Short Run Supply Curve Adjustment



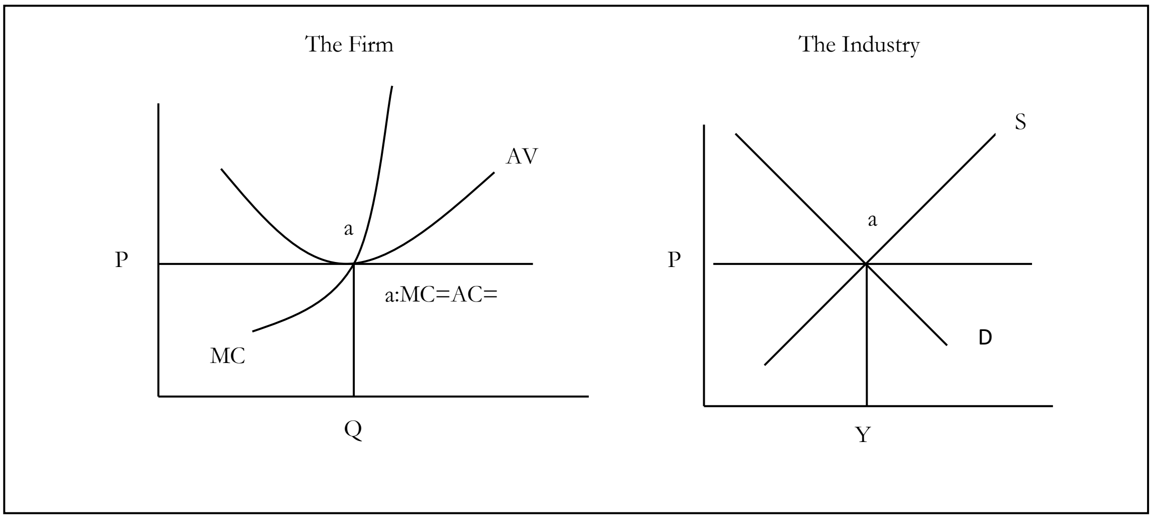
The market supply curve, which accounts for input price changes, is:

$$y = \sum_j S_j(P) = S(P), \tag{4}$$

where $S(P)$ is zero, greater than zero, or less than zero. The slope of this market supply curve depends on the extent that the increases in input demand increase input prices, and the resulting increases in the marginal costs at all output levels. When input prices rise, and the marginal cost rises above the market price of output, firms would adjust by producing less output; some firms may exit the market. When the input prices fall, and the marginal cost falls below the market price, firms produce more output, and some new firms may enter the market. When market price is equal to the marginal cost we have a competitive long-run equilibrium in the market.

The textbook Diagram for Perfect Competition in the long run is depicted in Diagram (2).

Diagram (2) – Perfect Competition, the Long Run



A competitive market is an efficient one. This entry into the market is a dynamic process, which lasts as long as the market price of the goods produced by the firms is > the marginal cost. The firm keeps adjusting its price in the short run. Entry into the market stops when the price is equal to the marginal cost, and firms exit the market when the price is below the marginal cost because the firm cannot cover its variable costs. Thus, a long run equilibrium condition requires $P = MC$. Such conditions should also indicate whether the market is competitive or not. Whether such conditions hold in macroeconomic data is a testable hypothesis. We do not expect such conditions to hold perfectly because fiscal policy (i.e., tax policy), monetary policy (i.e., the interest rate), regulations (i.e., minimum wage), trade barriers (i.e., tariffs), price subsidies, lack of antitrust power, and state monopolies among other interventionist policies could cause a wedge between the price and the marginal cost in the long run. However, this condition could tell us how far a certain market is from long run efficiency. Empirically, it is an approximate measure of efficiency and undoubtedly an informative one.

In diagram (2), P is the price, Q is the firm's level output, AV is the average cost curve, MC is the marginal cost curve, Y is the industry level output, D is the demand curve, and S is the supply curve. The individual firm maximizes output at the most efficient point of intersection of the marginal revenues and the marginal cost, whereby in the long run the price must be set equal to the marginal cost and the profits will be the normal economic profit. At the industry level, the price is determined by the intersection of demand and supply.

In this paper we want to use aggregated macroeconomic data for country levels to measure the point a, where $P = MC$ on the diagram (2) and to examine the deviations from such point. The closer the data are to this point the closer is the market to Perfect Competition and the more efficient it is.[2]

3. Methodology, Data, Measurements, and Evidence

At the country level, we use macroeconomic aggregated data of the consumer price index, the CPI_t, as a measure of the price level. The total cost curve $TC_t$is assumed to be a quadratic function of output y_t, and the marginal cost MC_t is the derivative of the total cost with respect to output:

[2] A Pareto-optimal state in the economy is the most efficient point and can be attained if: (1) The marginal rate of substitution between any two goods be equal for all consumers; (2) The marginal rate of technical substitution between any two inputs be equal in the production of all commodities, and (3) the marginal rate of product transformation be equal to the marginal rate of substitution for any two goods.

$$TC_t = \alpha y_t + \beta y_t^2 \text{ and the } MC_t = \frac{\partial TC_t}{\partial y_t} = \alpha + 2\beta y_t. \quad (5)$$

The values of α has no significant effect on the calculation because y_t is a large number so we will set it up equal to one, and one plus a large number is just the large number. And, the magnitude of β is irrelevant to the calculation because we will convert MC_t to an index, MCI_t, therefore, we set β equal to one.

4. Weaker-Form Perfect Competition: Do the Price level and the marginal cost share a common long-run trend?

A weaker-form of competition exists when the price level and the marginal cost are cointegrated, i.e., they share a long-run common trend. This is a bi-variat system, therefore, we use the Engle-Granger (1987) test, whereby the null hypothesis is that the CPI and the MCI are not cointegrated, i.e., they do not share a common long-run trend.[3]

Engle and Granger (1987) suggested six tests for cointegration. The test involves three steps. First, we regress one variable on the other using the Ordinary Least Squares method (OLS). One test for no cointegration is that a high $R^2$and a low Durbin-Watson statistic DWsuggests that the regression is Spurious, which implies cointegration. Second, they recommended using the ADF test to test the residuals of the regression in levels for unit root. Rejecting the unit root indicates that the two variables are cointegrated, i.e. the residuals are I(0).[4] Other tests for unit root can also be used, but the results will not change significantly. Third, the most important test for cointegration is estimating an Error Correction Equation and testing the significance of the coefficient of the error correction term (i.e. the lag residuals from the first stage level regression). A significant coefficient confirms the two variables are cointegrated.[5] For cointegration, we want the error correction term (the lagged residuals from the first stage regression) to have a high

[3] We could use the Phillips-Ouliaris (1990) test but the results would be the same.

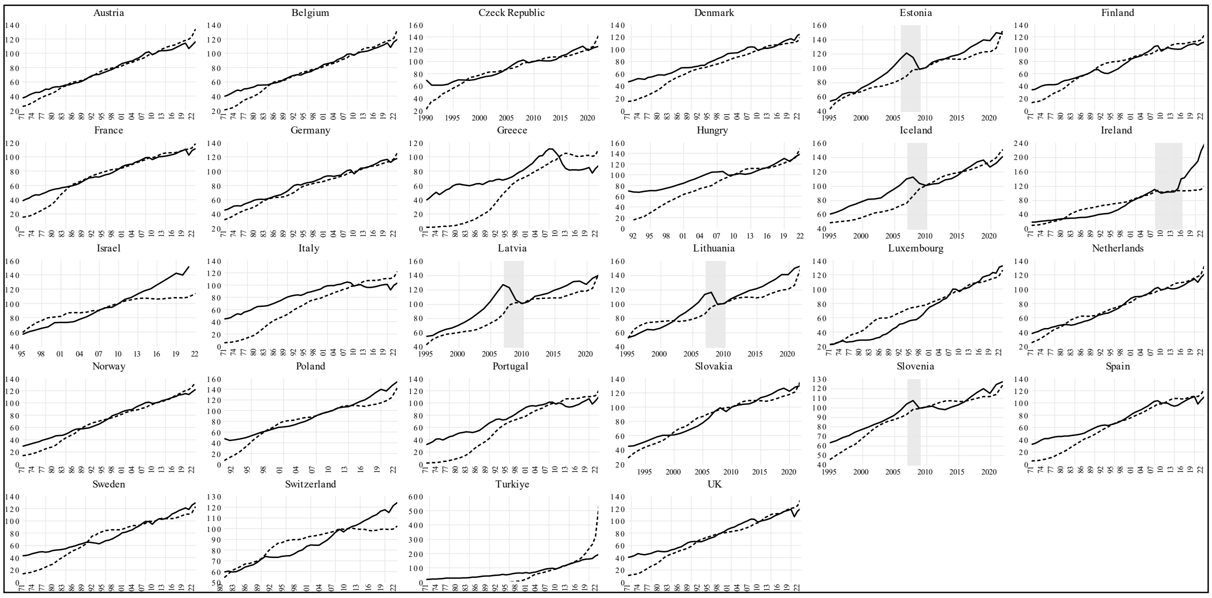
[4] The ADF is a weak test for unit root, i.e., it fails to reject more often. However, the power of any weak test is literally meaningless when it reject the null hypothesis.

[5] Note that the distribution of t stat of this *estimated* coefficient is non-standard, therefore, we would only consider a very high t stat (or zero P value) as indicative of statistical significance.

t value (zero P-value). Testing for cointegration between the CPI_t and MCI_t requires identifying the trends first. The data must be differenced-stationary. In simple terms, each time series must have a unit root.

First we plot the data. Figure (1) plots the time series for the European countries. The samples may vary, but most of the data are from 1970 to 2022. Real GDP data used to compute the marginal cost index MCI_t (2010=100) are taken from the OECD statistics. The CPI_t (2010=100) is taken from the Bank for International Settlements (BIS).

Figure (1) – The European Data



Marginal Cost Index (2010=100) Solid line and the Consumer Price Index (2010=100) dotted line

There are trends in all data. Many countries experienced higher marginal costs in the early 1970s. We speculate that oil price shocks and high real interest rates might have contributed to that. The shaded areas, in a few countries, show potential breaks in the data around the period of the Global Financial Crisis in 2007 and the Great Recession in 2009. Figure (2) plots the US, the EU-19, and the EU-27 data. Similar trends and possible breaks in the European data are visible. Figure (3) plots the Australian and New Zealand data. Both countries have similar patterns to the US and the European countries, with the marginal cost above the price level in the 1970s and 1980s. Figure (4) plots two South American countries' data.

Figure (2) – The US, EU-19, and EU-27 Data

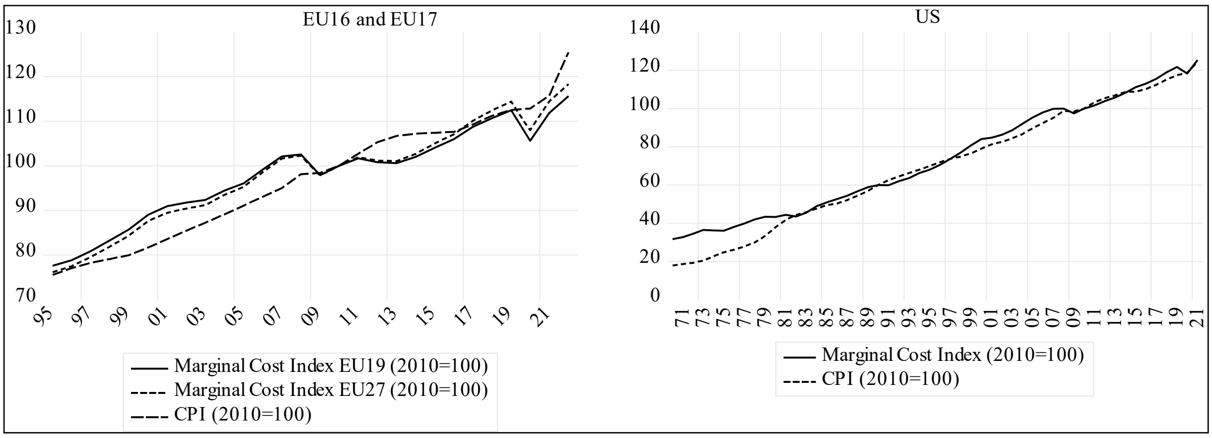


Figure (3) – Australasian Data

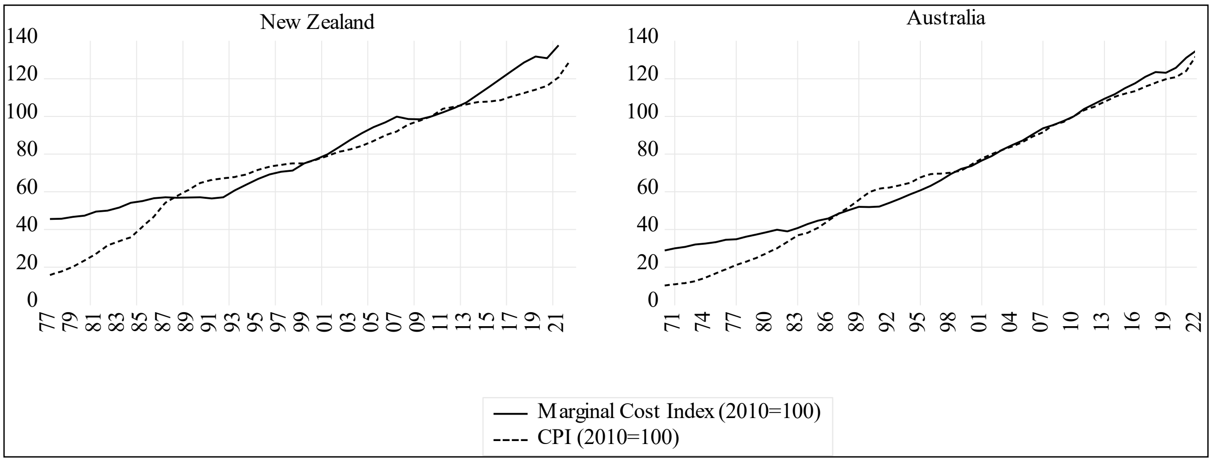
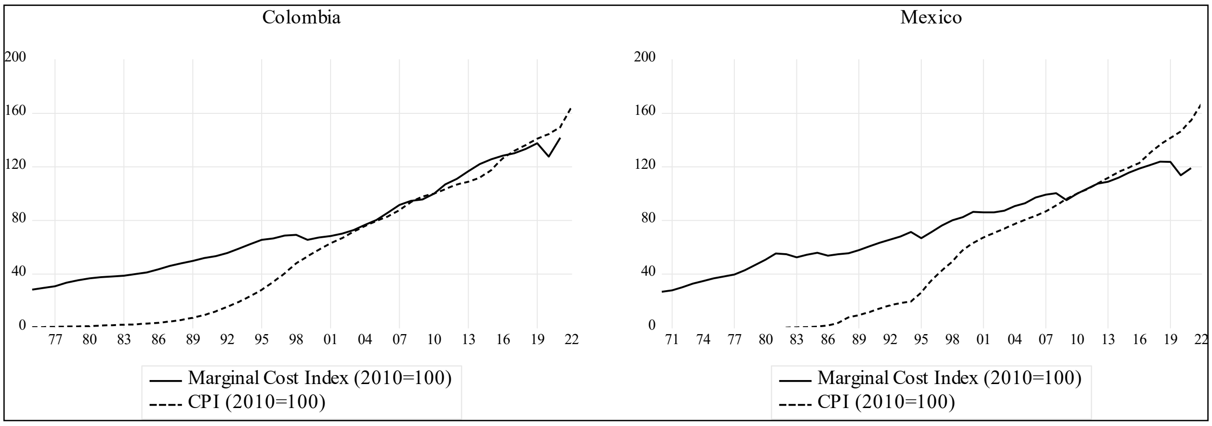
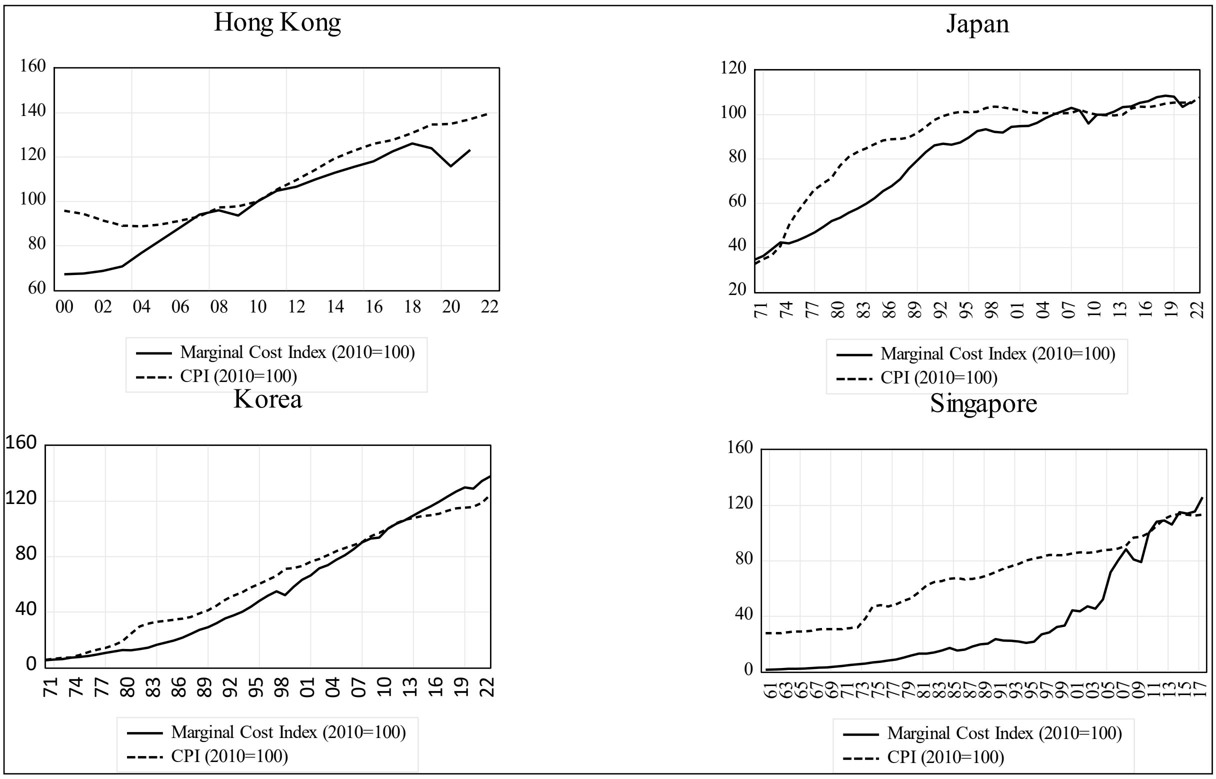


Figure (4) – Two South American Countries



Colombia and Mexico also have the marginal cost above the price level in the 1970s and the 1980s but also in the 1990s.

Figure (5) – The Asian Data



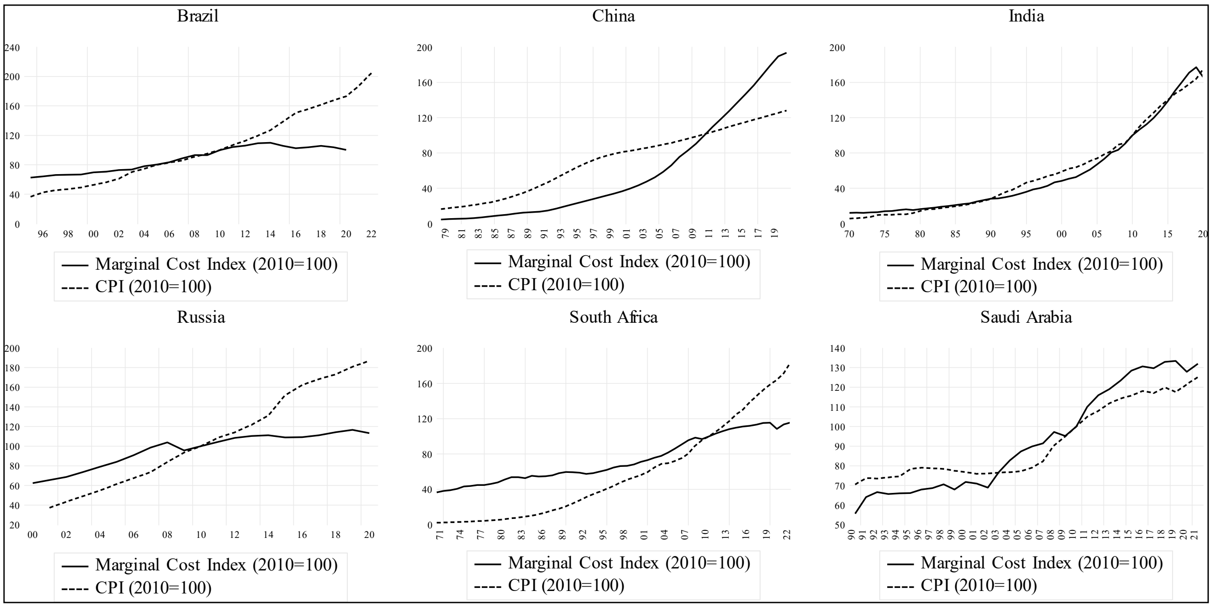
Data Source for Singapore's real GDP is the Federal Reserve Bank of St. Louis (FRED)

Figure (5) plots the Asian countries in our sample. The data show similar trends, albeit the price level is above the marginal costs from the 1970s, which is different from the European and the US data. And finally we plot the BRICS plus Saudi Arabia in figure (6). The trends are visible in the data. Brazil, Russia and South Africa look more similar than the others, and the marginal cost above the price level like the US, Europe, Australasia and South American data. Clearly, China and Saudi Arabia data have different patterns than the others, and India has the marginal cost almost equal to the price level.

The Nature of the Trend

Notwithstanding Phillips' (2003) argument about the difficulty to predict the trend, testing for a meaningful long-run common trend requires the CPI_t and MCI_t to have unit roots, i.e. stochastic trends. Put simply, each time series has to be *differenced-stationary*. It is easier said than done, however. For robustness, our strategy is to test for the nature of trend using a number of commonly used tests such as the Dickey – Fuller (1979), the Augmented Dickey – Fuller test (Said and Dickey, 1984), the Phillips – Perron (1988) test, the GLS – ADF Elliot *et al.* (1996), and Ng – Perron (2001. In cases where we are uncertain about the unit root we use the Wiatkowski, Phillips, Schmidt, and Shin (KPSS) Test.[6] We also test for unit root with break in some cases.[7] Keep in mind though that these tests have low powers against stationary alternatives, i.e. they tend not to reject the null hypothesis more often. The other concern is that these tests might have difficulty distinguishing a root of 1 from, say 0.98; see for example Rudebusch (1993) and Cochrane (1991) among many others for example.

Figure (6) – BRICS Data



For each test, we use a number of specifications. We use regressions without an intercept and linear trend, with an intercept only, and with an intercept and linear trend but we are more concerned with the last specification because we need to test for unit root and deterministic trend. In each test and each specification, we use a number of Information Criteria to determine the number of lag differences in the regressions. Note that these different specifications have different distributions. We do not report the results of these

[6] We cannot compare the power of these unit root tests with the power of the KPSS because the KPSS test's null hypothesis is "no unit root" or I(0) while the other tests null is I(1), hence power comparison is not inapplicable.

[7] There are more tests for unit root, but we doubt it very much if the results would change significantly. However, the most concerning issue, which we do not address here, is whether the true Data Generating Process (DGP) of either the CPI or MCI is *nonlinear*, thus a nonlinear unit root test is required. We say that because the unit root tests above fit a linear line through the data; they would confuse breaks in the data, if any, with nonlinearity. Nonetheless, nonlinear unit root is a probability, for example see Kapetanios, Shin, and Snell, (2003).

tests and specifications because the output is very large, some produce exact same results, and the output takes a lot of space; however, the results of the various regressions across all different tests are not different in any significant way. They all indicate that the trend in the data is stochastic, i.e., the time series data have unit root, hence differenced stationary. One thing we are sure about is that neither the CPI_t nor the $MCI_t$is I(0), therefore, it seems defensible to carry on with the conclusion of the unit root in the data.

Cointegration

Table (1) reports the tests for cointegration. The table has three tests: (1) the Spurious regressions in the levels with high $R^2$and low DW, which indicate that the CPI_t and $MCI_t$are cointegarted; (2) the ADF test of the residuals from the first regression in levels, which is statistically significant at the 5 percent level in 29 countries (Australia, Austria, Belgium, Estonia, Finland, France, Germany, Hungry, Iceland, India, Japan, Latvia, Lithuania, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, UK, and the US). The EU-19 and EU-27 also have significant ADF tests. There are four countries where the ADF test is significant at the 10 percent level (Colombia, the Czech Republic, Korea, and Hong Kong). The rest of countries' ADF test is insignificant. These are Ireland, Israel, Italy, Mexico, Switzerland, Turkiye, South Africa, and Russia. The third test (the ECM) is the most important test for cointegration. We found 14 countries plus the EU-19 and the EU-27 with significant error correction terms, i.e., high t statistics (Australia, Austria, Belgium, Colombia, the Czech Republic, Denmark, Estonia, Israel, Lithuania, Poland, Portugal, Slovakia, and the US. Hong Kong's t statistics is 2.0, which is probably insignificant in this case. The rest of the countries ECM are insignificant.[8] The evidence is mixed, however, indicates that there exists a weaker-form of Perfect Competition in many countries.

[8] Ireland's ECM is problematic because the error correction term is positive. Switzerland too has very difficult data to fit too and the ECM term is positive. We tried to fit a linear trend and a constant term in the level's regression, but the ECM remained positive.

Table (1) – The Engle-Granger (1987) Test - H_0: No Cointegration

No	Country	Sample	OLS: $CPI_t = \alpha MCI_t + \varepsilon_t$ i				ADF ε_t ii	$\Delta CPI_t = \beta \Delta MCI_t + \rho \varepsilon_{t-1} + v_t$ ii	
			α	P-value		DW	(P values)	ρ	(t_ρ/P values)
1	Australia	70-22	0.96 [1.5954/3]	0.0000	0.79	0.02	(0.0199)*	-0.08 [1.9888/3]	(-3.4/0.0014)
2	Austria	70-22	0.99 [4.5793/3]	0.0000	0.91	0.04	(0.0098)*	-0.09 [5.2770/3]	(-2.5/0.0134)
3	Belgium	70-22	0.98 [2.3614/3]	0.0000	0.81	0.03	(0.0845)*	-0.08 [4.6240/3]	(-3.6/0.0006)
4	Colombia	75-22	0.75 [7.6089/3]	0.0000	0.31	0.00	(0.1826)#	-0.04 [3.5123/3]	(-5.1/0.0000)
5	Czech R	90-22	0.98 [3.3769/3]	0.0000	0.64	0.23	(0.1426)#	-0.38 [3.1663/3]	(-5.1/0.0000)
6	Denmark	70-22	0.94 [4.7709/3]	0.0000	0.65	0.02	(0.0031)*	-0.08 [2.4314/3]	(-3.5/0.0011)
7	Estonia	95-22	0.97 [2.1878/2]	0.0000	0.91	0.55	(0.0417)*	-0.29 [1.7453/2]	(-2.6/0.0154)
8	Finland	70-22	0.98 [4.9746/3]	0.0000	0.74	0.03	(0.0060)*	-0.09 [6.6287/3]	(-3.2/0.0024)
9	France	70-22	0.97 [3.5254/3]	0.0000	0.87	0.04	(0.0111)*	-0.06 [5.1955/3]	(-1.7/0.0910)
10	Germany	70-22	1.10 [5.9522/3]	0.0000	0.98	0.49	(0.0024)*	-0.17 [4.5134/3]	(-1.4/0.1639)
11	Greece	70-22	1.93 [5.4016/3]	0.0000	0.74	0.10	(0.0307)*	-0.03 [1.0991/3]	(-1.1/0.2569)
12	Hungry	92-22	1.69 [3.9916/3]	0.0000	0.91	0.34	(0.0006)*	-0.16 [2.6228/3]	(-1.4/0.1603)
13	Iceland	95-22	1.31 [7.0711/2]	0.0000	0.88	0.35	(0.0082)*	-0.11 [5.3915/2]	(-1.1/0.2460)
14	Ireland	70-22	0.78 [4.0803/3]	0.0000	0.43	0.04	(0.3116)	0.03 [3.4046/3]	(1.6/0.1100)
15	Israel	95-21	0.46 [2.8488/2]	0.0000	0.85	0.19	(0.3096)	-0.19 [4.2323/2]	(-2.3/0.0267)
16	Italy	70-22	1.90 [3.8145/3]	0.0088	0.93	0.19	(0.1389)	-0.06 [3.8759/3]	(-0.59/0.5570)
17	Japan	70-22	0.79 [4.3144/3]	0.0000	0.84	0.08	(0.0089)*	-0.08 [2.2749/3]	(-1.5/0.1475)
18	Latvia	95-22	0.92 [2.1196/2]	0.0000	0.84	0.39	(0.0372)*	-0.19 [2.3607/2]	(-0.02/0.9838)
19	Lithuania	92-22	0.70 [1.6645/2]	0.0000	0.88	0.63	(0.0521)*	-0.29 [1.2673/2]	(-2.6/0.0159)
20	Luxembourg	70-22	0.79 [4.0750/3]	0.0000	0.94	0.09	(0.0071)*	-0.07 [8.4970/3]	(-1.2/0.2279)
21	Mexico	70-21	1.69 [1.5370/3]	0.0000	0.92	0.14	(0.1140)	-0.05 [2.7848/3]	(-0.66/0.5104)
22	Netherlands	70-22	1.08 [3.2258/3]	0.0000	0.96	0.18	(0.0033)*	-0.09 [3.0240/3]	(-1.5/0.1301)
23	New Zealand	77-21	1.00 [5.3479/3]	0.0000	0.87	0.06	(0.0144)*	-0.06 [2.2353/3]	(-1.2/0.2488)
24	Norway	70-22	1.19 [1.5451/3]	0.0000	0.97	0.12	(0.0640)*	-0.04 [1.7610/3]	(-0.45/0.6531)
25	Poland	90-22	0.92 [3.1937/3]	0.0000	0.85	0.10	(0.0315)*	-0.16 [3.2691/3]	(-3.5/0.0015)

26	Portugal	70-22	1.67 [4.2780/3]	0.0000	0.96	0.33	(0.0008)*	-0.12 [3.3162/3]	(-2.2/0.0331)
27	Slovakia	92-22	0.98 [2.0660/3]	0.0000	0.94	0.33	(0.0255)*	-0.19 [3.9010/3]	(-1.8/0.0749
28	Slovenia	95-22	0.95 [3.3056/2]	0.0000	0.88	0.23	(0.0277)*	-0.21 [3/0592/2]	(-1.2/0.2248)
29	Korea	70-22	0.95 [4.7712/3]	0.0000	0.97	0.09	(0.0764)#	-0.04 [5.0053/3]	(-1.3/0.1910)
30	Spain	70-22	1.45 [3.73030/3]	0.0000	0.96	0.25	(0.0011)*	-0.03 [4.1074/3]	(-0.43/0.6631)
31	Sweden	70-22	0.95 [3.3872/3]	0.0000	0.80	0.03	(0.0350)*	-0.05 [2.2428/3]	(-1.3/0.1955)
32	Swiss	80-22	0.98 [3.7282/3]	0.0000	0.50	0.04	(0.6194)	0.03 [4.3026/3]	(1.4/0.1656)
33	Turkiye	70-22	3.49 [7.8263/3]	0.0519	0.89	0.76	(0.0004)*	-0.16 [2.4707/3]	(-0.18/0.8559)
34	UK	70-22	1.32 [2.9208/3]	0.0000	0.94	0.22	(0.0068)*	-0.04 [3.0548/3]	(-0.62/0.5389)
35	US	70-22	0.96 [3.2939/3]	0.0000	0.96	0.08	(0.0206)*	-0.09 [6.3068/3]	(-3.5/0.0008)
36	EU19	95-22	1.27 [6.2284/2]	0.0000	0.92	0.56	(0.0443)*	-0.16 [4.1539/2]	(-2.5/0.0173)
37	EU27	92-22	1.15 [7.8907/2]	0.0000	0.94	0.61	(0.0352)*	-0.21 [3.2892/2]	(-2.5/0.0184)
38	China	78-20	0.55 [2.9003/3]	0.0000	0.78	0.04	(0.0463)*	-0.02 [3.0123/3]	(-0.66/0.5094)
39	Singapore	60-17	0.63 [5.0311/3]	0.9049	0.77	0.07	(0.0482)*	-0.02 [4.9071/3]	(-0.43/0.6682)
40	India	70-20	1.01 [5.0010/3]	0.0000	0.98	0.34	(0.0070)*	-0.09 [4.7559/3]	(-0.39/0.6976)
41	Saudi Arabia	90-21	0.96 [2.0678/3]	0.0000	0.94	0.39	(0.0376)*	-0.17 [2.5853/3]	(-1.6/0.1244)
42	South Africa	70-22	2.04 [4.8174/3]	0.0000	0.94	0.13	(0.1660)	-0.01 [4.1374/3]	(-0.15/0.8784)
43	Brazil	95-20	2.28 [4.5285/2]	0.0484	0.80	0.17	(0.0322)*	-0.04 [3.5291/2]	(-0.14/0.8893)
44	Hong Kong	00-21	0.78 [5.3653/2]	0.0000	0.81	0.18	(0.0646)#	-0.17 [2.8191/2]	(-2.0/0.0581)
45	Russia	01-20	2.75 [1.7696/2]	0.0355	0.80	0.30	(0.3479)	-0.10 [1.6132/2]	(-0.36/0.7201)

(i) We removed the constant term when it is found insignificant, and we do not report the constant terms in the first level's regression. The regression's standard errors and covariance are HAC, pre whitening with lags from AIC, Bartlett kernel, Newey-West with an automatic bandwidth **(ii)** ADF is the Augmented Dickey-Fuller test with lag =1 based on AIC **(iii)** The EC regression's standard errors and covariance are HAC, pre whitening with lags from AIC, Bartlett kernel, Newey-West with an automatic bandwidth. Asterisk denotes significant at the 5 percent level and Hash denotes significant at the 10 percent level. Square brackets include the bandwidth/lags used to compute the kernels.

5. Stronger-Form Perfect Competition: Is the CPI equal to the MCI in the long run?

The next and final test involves extracting the stochastic trend from the data. The trend represents the long run. We use the Hodrick-Prescott (1997) filter (HP filter), and the Optimal Band-Pass (BP) filter - (Christiano – Fitzgerald, 2003). Figures (7) to (11) are the 45°- line scatter plot of the HP filtered data. The filtered trend is fluctuations in the data higher than 8 years. The trend is nearly identical from these two methods even though the BP filter extracts the noise (i.e., high frequency below 2 years).

Figure (7) plots the European countries 45° line scatter plots. The deviations from Perfect Competition are visibly large in general, except for a few countries, which have remarkably small deviations from the 45° line; Austria, Belgium, the Czech Republic, and Denmark, France, Germany, Lithuania, the Netherlands, Norway, and Slovakia, have relatively stronger-forms of Perfect Competition, except for the 1970s and 1980s. The next plot figure (8) is for the United States and the EU-19 and EU-27. It shows that there is evidence for a strong-form competition in the US.

Figure (7) - 45°- Line Scatter Plots - Europe

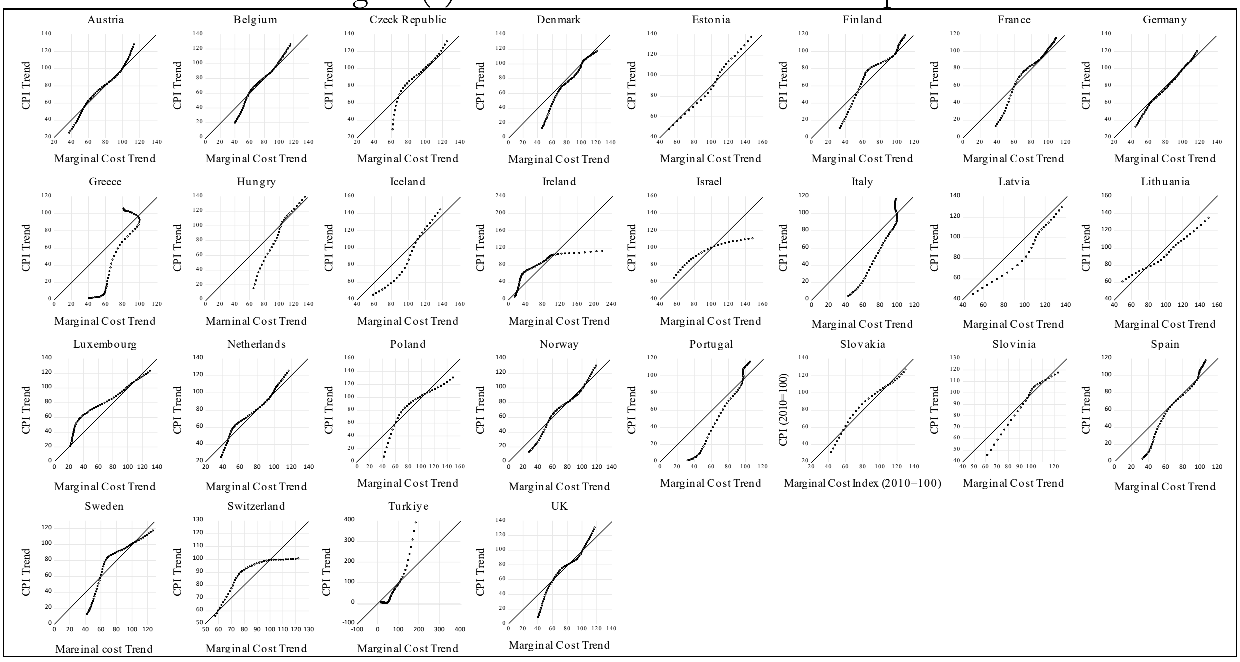
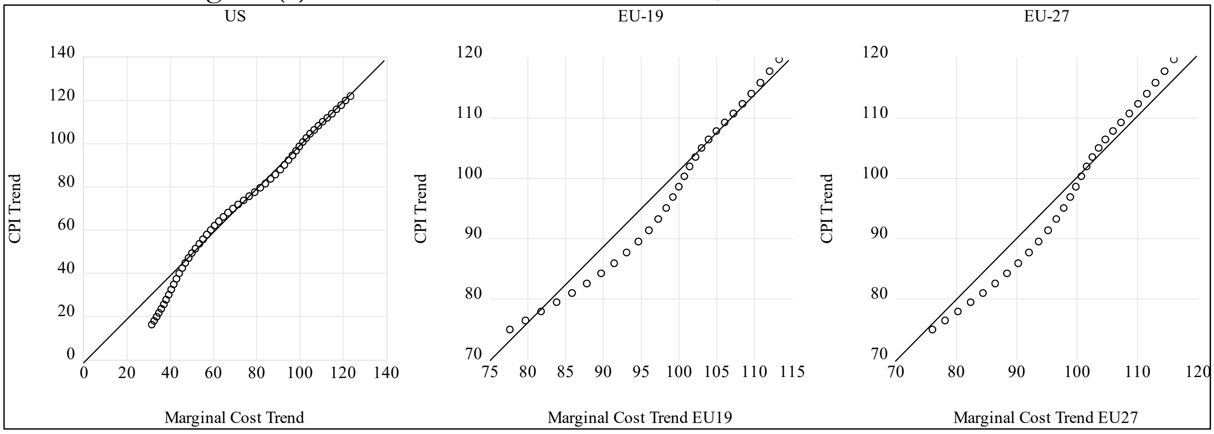


Figure (8) - 45°- Line Scatter Plots – US, EU-19 and EU-27



The US market exhibits a stronger-form competition that exceeds the competition we see in European countries.

New Zealand, the Asian, the two South American countries, and the BRICS data do not exhibit a stronger-form competition, except for Australia and India. India's deviation from Perfect Competition is minimal. In the BRICS, only India exhibits a stronger-form competition. India and the US data have the smallest deviations from perfect completion at the macro level. Figures (8), (9), (10) and (11) plot the 45° line scatter plots. Both the Asian and South American two countries in our sample show very significant deviations from a stronger-form competition, and very significant differences from the US and Europe. Policymakers in the rest of the world who care about competition should take this preliminary evidence when formulating policies. It would be a starting point for understanding the issue. Policies are the main source of the wedge between prices and cost. A tax rate on the prices of goods and services or a subsidy, for example, alters the equilibrium condition, i.e. increase and decrease equilibrium market price. Monetary policy affects the interest rate – the rental price of capital and creates a wedge. Trade barriers, oil price shocks, regulations etc. are all factors that could be tested. There are two future research questions to be asked. First is to examine the industry level data, and the firm level data if available. The industry level data for the EU, the US and Japan are readily available. These micro data could show the location of the underlying lack of competitiveness and inefficiencies. Second is to explain the deviations from Perfect Competition.

Figure (8) - the 45° line scatter plots – Australasia

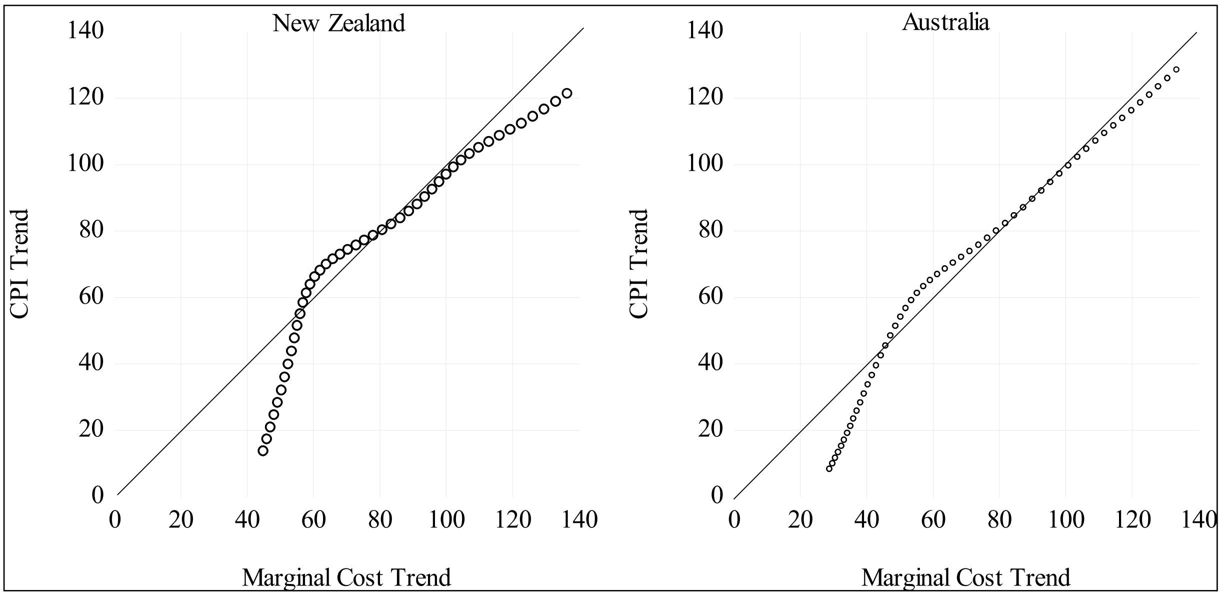


Figure (9) - the 45° line scatter plots – Asia

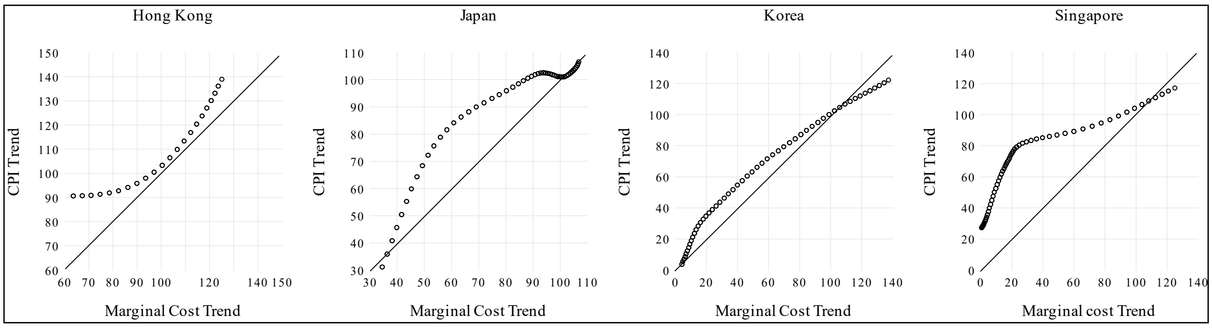


Figure (10) - the 45° line scatter plots – South America

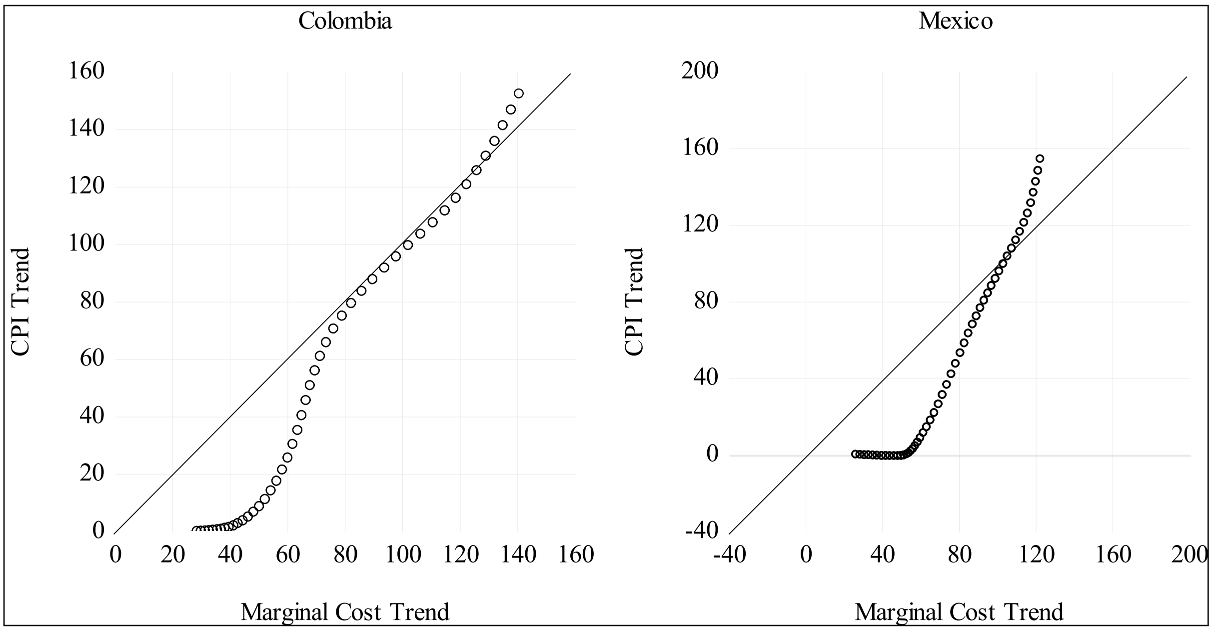


Figure (11) - the 45° line scatter plots – BRICS

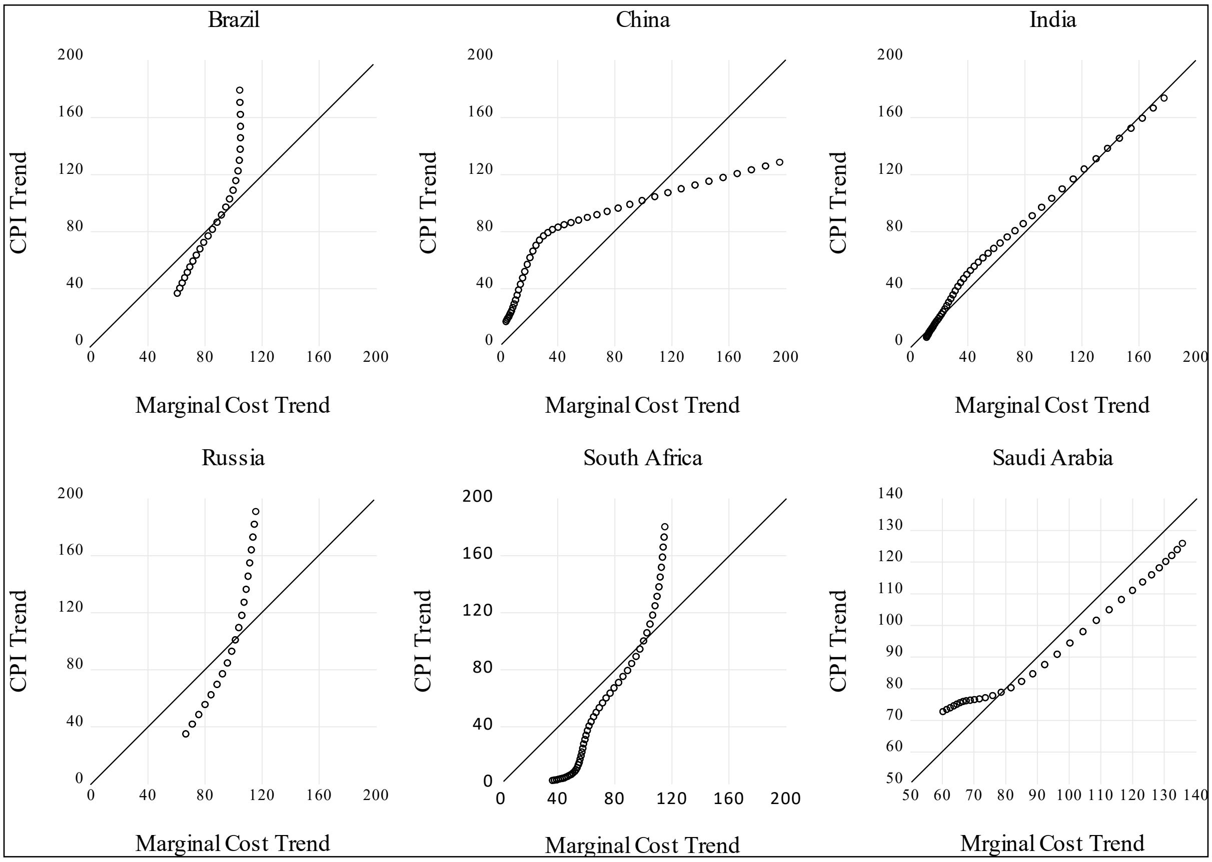
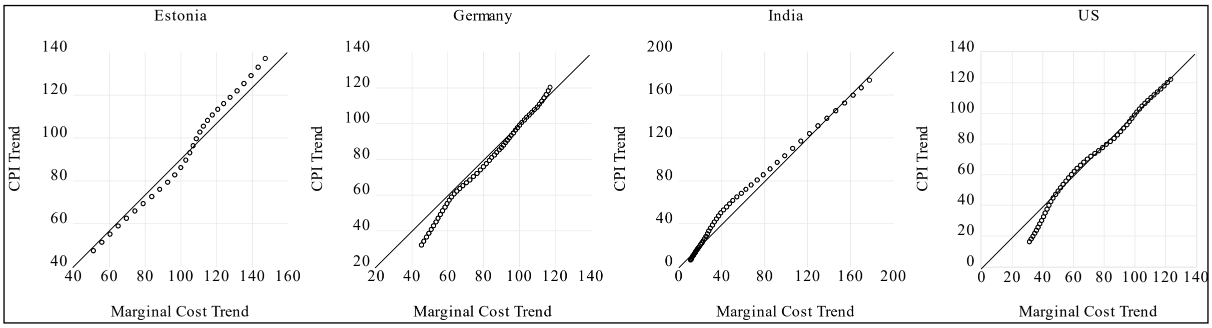


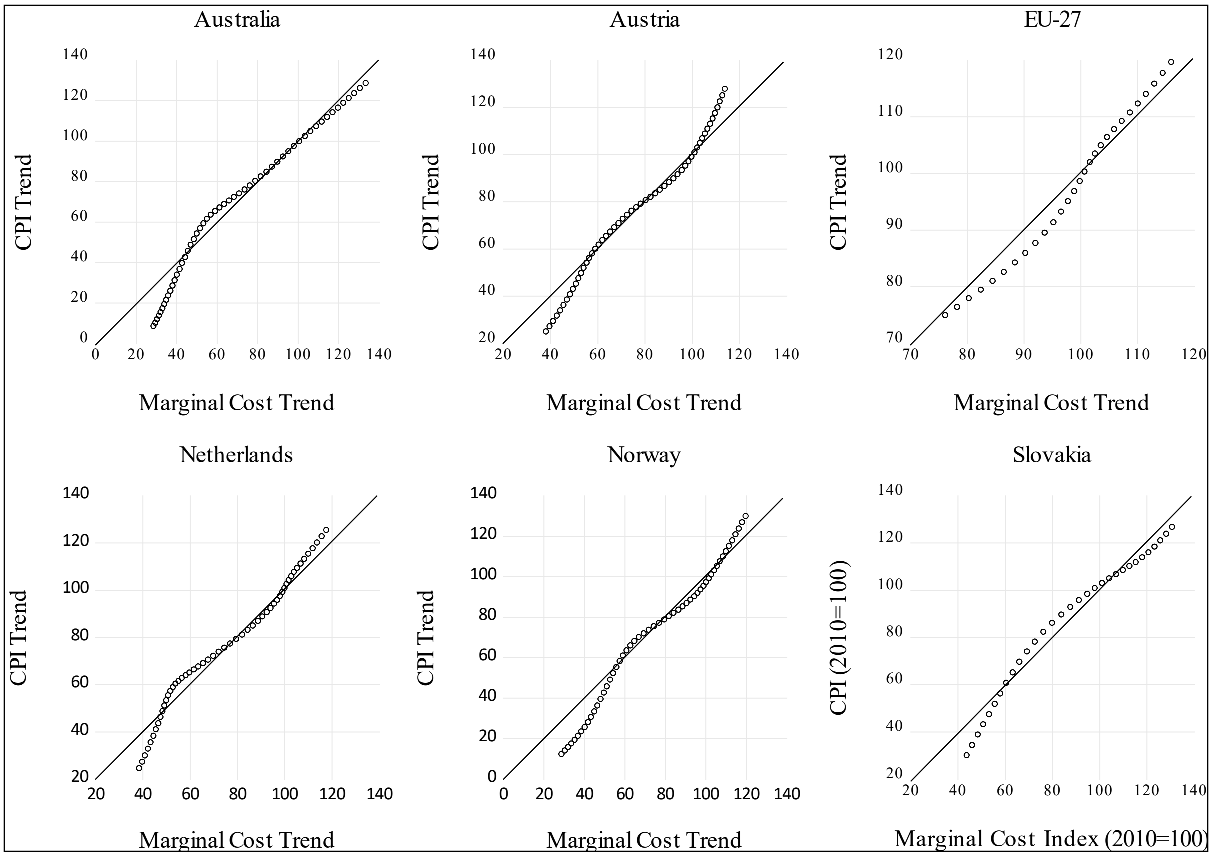
Figure (13) plots 4 scatter plots of $CPI_t$and MCI_t, which identify as the most competitive markers because they have the smallest deviations from the $45°$ line.

Figure (13) – Most Competitive Countries – Smallest Deviations from Perfect Competition



Relatively less competitive countries, in the sense that there are relatively slightly larger deviations from the 45° lines are plotted in Figure (14). The rest of the countries, 34, are far less competitive.

Figure (14) – Relatively Lesser Competitive Countries



6. Conclusion

One of the pillars of the capitalist free market philosophy is perfect competition. The idea is that the market is populated by a large number of firms producing homogeneous goods, and services. The size of each firm is relatively small such that it cannot set the price, hence a price taker. These firms compete in order to make profits. When the price exceeds the marginal cost, they make profits and that would motivate more production and more firms to enter the market. The opposite is true. Firms would exit from the market if they cannot cover the marginal cost, i.e. when the price is below the marginal cost. There are clearly adjustments to be made to production over the short run, which all firms do. In the long run, the price is supposedly equal to the marginal cost, and there would be no entry and no exit in the steady state.

In this paper we confronted this microeconomics theory with macroeconomics data from 43 countries. We used annual data for the CPI as a measure of the price level. We assumed a quadratic total cost function and computed the derivative as a simple measure of the marginal cost. We tested two forms of Perfect Competition, a weak-form and a strong-form. Since Perfect Competition is a long-run steady-state condition, the weak-form is cointegration. In a simple term, the price level must be cointegrated with the marginal cost; they share a common trend in the long run. We found more evidence for it in the data. Our bi-variate Engle-Granger (1987) one of three tests suggested by Engle and Granger rejected the null hypothesis that the price level and the marginal cost are not cointegrated in almost all countries. The ADF test of the residuals of the level regressions of the price level on the marginal cost strongly rejected the null hypothesis of no cointegration in 34 cases. However, the most important test, which is an ECM, rejected the null of no cointegration in 16 cases. Therefore there exists a significant amount of support in the macroeconomics data for a weak-form of Perfect Competition.

A stronger-form of competition exists only if the price level is *equal* to the marginal cost in the long run. In equilibrium, the marginal revenue is equal to the marginal cost. We plot a simple nonparametric 45° line scatter plot of the price level and the marginal cost trends. The trends are obtained from the HP filter. We could only find four countries, where such Perfect Competition holds in macro data. Estonia, Germany, India, and the

US are the most competitive economies in the sense that the deviations from the 45° line are the smallest. There are relatively less competitive economies, where the deviations from the 45 line are slightly larger. These are Australia, Austria, the Netherlands, Norway, Slovakia, and the EU-27.

The results are informative. The microeconomic equilibrium condition that the price level is equal to the marginal cost in the long run holds in fewer countries. The majority of the countries exhibit a weaker form of Perfect Competition, where the price level and the marginal cost only share a common trend in the long run. The results could inform the policymaker on the state of competition in their economies. The next level of research should be at the industry level, which gives the policymaker more information about the source of inefficiency in the economy.

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