# The impact of the declining USD on the terms of trade for the euro zone with the US.

(period 2002-2007)


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# Frequently used abbreviations

| | |
|---|---|
| **AC** | **Average Costs** |
| **BOP** | **Balance of Payments** |
| **BOT** | **Balance of Trade** |
| **CA** | **Current Account** |
| **CPI** | **Consumer Price Index** |
| **ECB** | **European Central Bank** |
| **EMU** | **European Monetary Union** |
| **ER** | **Exchange Rate** |
| **ERPT** | **Exchange Rate Pass Through** |
| **EUR** | **Euro** |
| **EZ** | **Euro Zone** |
| **FED** | **Federal Reserve Bank** |
| **HICP** | **Harmonized Index of Consumer Prices** |
| **IMF** | **International Monetary Fund** |
| **LOP** | **Law of one Price** |
| **MC** | **Marginal Costs** |
| **MFM** | **Mundell Fleming Model** |
| **MLC** | **Marshall Lerner Condition** |
| **MNE** | **Multi National Enterprises** |
| **NER** | **Nominal Exchange Rate** |
| **PCP** | **Producer Currency Pricing** |
| **PPI** | **Producer Price Index** |
| **PPP** | **Purchasing Power Parity** |
| **PTC** | **Pass Through Coefficient(s)** |
| **PTM** | **Pricing to Market** |
| **RER** | **Real Exchange Rate** |
| **SITC** | **Standard International Trade Codes** |
| **TOT** | **Terms of Trade** |
| **US** | **United States** |
| **USD** | **United States Dollar** |

## 1. Introduction of the problem:

International trade is one of the main topics within the fields of international economics and its importance is still growing; mainly due to ever increasing globalization and the slow but certain decline of trade barriers. Even hundreds of years ago trade between different nations took place but besides the obvious advantages there are some barriers that have to be overcome when trading with other nations. These barriers can be divided between technical, geographical and economical barriers.

With the foundation of the General Agreement on Tariffs and Trade (GATT) in 1948 some economic barriers of global trade have been declined and with the foundation of the World Trade Organisation (WTO), the successor of the GATT, this process still continues; though slowly. Several regions in the world organised themselves in so called (free) trade unions increasing trade between countries that form those trade regions.

Two of the world's largest trade regions are the North American Free Trade Agreement (NAFTA) in which the United States (US) is with distance the biggest member and the Eurozone (EZ); the EZ's intra trade volume is the world's largest trade flow if one takes a look at trade regions.

Although the share of total world exports of both regions declined during the last 10 years both regions still account for over 45% of total world exports in services. Looking at merchandise export the same development, though stronger, can be observed. Both regions account for approximately one third of total merchandise exports. An important reason for the stronger decline in total merchandise exports compared to exports of services is the rise of merchandise exports from China.

Because of the ever increasing importance of international trade, (economical) factors that influence international trade have received increased attention in the field of international economics. These factors include tariffs, (regional) trade agreements, new technologies, changes in international economic importance of countries and regions and exchange rates (ER). This thesis will focus on the impact of movement in the bilateral ER (EUR/USD) on trade between the EZ and the US.

From 2002 until the summer of 2008 the US dollar has almost continuously depreciated against the Euro. Basic trade theory, most notably the Marshall Lerner condition (MLC), suggest that this should lead to deteriorating terms of trade for the EZ (The EZ in this thesis consist of the first twelve members since data covering a longer period is needed to get reliable statistical outcomes). The MLC basically states that a home country's trade balance is negatively affected by an appreciating real exchange rate (RER); since this makes the country's tradable goods more expensive for trading partners.

In this case, according to this condition, this should have led to movements in the US/EZ trade balance implying a decrease in the US trade deficit with the EZ; or even a US surplus. When one takes a look at aggregated trade data, it can be concluded that the opposite has happened; in this regard it is also particular that this held for each individual EZ member. It is however also the case that EZ imports from the US increased during this period. The MLC however assumes that changes in RER are, at least to a certain extent, translated in the prices of tradable goods. The same assumptions have even made certain European politicians to comment on European Central Bank (ECB) policy and the role and functioning of the ECB. Also the current French managing director of the International Monetary Fund (IMF), Dominique Strauss-Kahn, suggests that there should be a political counterweight for the ECB.

This thesis will investigate to what extent these specific concerns regarding the role of (R)ER are justified and to what extend (R)ER do indeed effect the terms of trade (TOT) of the EZ and in what ways. A special focus in this thesis concerns Exchange Rate Pass through (ERPT). ERPT measures to what extent RER movements are transferred in to prices of tradable goods. Price elasticity's also play a role since it measures the effect on changes of relative prices on the demand of, in this case, tradable goods. Although price elasticity's play an important role this effect will not have a prominent role in the quantitative analysis of this thesis. Again, this thesis focuses on RER and thus relative prices, and its effect on demand for tradable goods.

While the main purpose of this thesis will be the role of RER movements on the TOT there are obviously a lot of other channels in which the depreciating USD affect(ed) the position of exporting companies in the EZ. By incorporating these other channels a more complete picture of the rather puzzling empirics can be given and suggestions for further research can be obtained.

*Formulation of the main problem:*

**To what extent are concerns regarding the development of the EUR/USD rate, during the period 2002-2007 justified, when one focuses on the TOT of the EZ and what are the ERPT coefficients of the three most important EZ sectors exporting to the US?**

The relevance of this question should be obvious since it has important implications on several areas. First it has important macro-economic implications for instance that it can affect monetary and trade policies and welfare issues in general. Furthermore from a micro economical perspective it directly affects pricing behaviour of Multi National Enterprises and how MNE cope with ER volatility. The focus in this thesis will be at the implications on an aggregate level i.e. macro-economic implications.

A final note regarding the relevance of the formulated problem is the current economic situation in which different countries blame each other for keeping ER artificially low to stimulate exports; i.e. the "beg thy neighbour policy"). The motivation for choosing the EZ and the US as the regions to investigate should be obvious to since these regions are still economically the most important regions in the world today.

Besides the main question of this thesis, other important questions will be addressed to form a more complete picture of the main problem. It is important to understand the composition of exports from the EZ to the US and how the trade balance between the EZ and the US is developing. Possible other factors which influence EZ exports to the US will also be addressed.

The rest of this thesis is structured in the following way. Section 2 outlines basic theories like the Mundell Fleming Model (MFM), the theory of purchasing power parity (PPP) and the MLC. Furthermore some of its short comings will be discussed briefly. Section 3 provides an overview regarding literature of the theories outlined in section 2 and will elaborate on literature regarding ERPT. Section 4 will consist of own research regarding the main problem outlined above. Finally section 5 will present the conclusions and suggestions for further research.

# 2. Economic theories regarding ER and trade

*2.1 Introduction*

After the Second World War the USD became the most important and single reserve currency in the global financial system where the value of the USD was pegged to the price of gold. Lots of other economical important countries fixed their ER to the value of the USD. This system implied, more or less, fixed ER and therefore swings in the value of currencies did not incur in the way it does in the post Bretton Woods era. Therefore ER movements obviously received less attention in economic literature than nowadays. After abandoning the Bretton Woods system the implications of a floating ER regime and the effects on international trade became very relevant and received great attention in economic research.

This relevance relates to several economic issues for instance monetary policy, trade policy, market integration and industrial organization. ER can therefore been seen as both a micro and macro issue making it a complex phenomenon to investigate. As mentioned earlier, this thesis will mainly focus on the macro economic implications of floating ER regimes and the impact of ER movements on international trade. More specific it will focus on the impact of ER movements in the EUR/USD on consumer prices of exported goods from the EZ sold to the US. The impact of a 1% rise in the EUR/USD on the price of the above mentioned export prices, is an important way to study the impacts of ER movements regarding the trade balance.

When discussing ER it is important to first stress out which definition of ER is used and why it is used. In understanding why, it is important to know the distinctions between the different kinds of ER used in economic literature. In this regard two definitions used most frequently are nominal and real ER which will be outlined below. This is important because the explanation of definitions defer in literature. The nominal exchange rate (NER) is mostly explained as the home currency price of a unit of foreign exchange, so in this case it is the number of Euros we have to pay in order to purchase one dollar. The RER is obtained by adjusting the NER by relative prices; for instance the Consumer Price Index (CPI) or Producer Price Index (PPI).

The RER can be shown in the following equation:

$$Q = S\frac{P_{US}}{P_{EZ}} \qquad (2.1)$$

Here $SP_{US}$ is a bilateral NER, in this case EUR/USD divided by a measure or estimator of the price level in the home country. In this case Q can be seen as the price of goods from the US relative to the price of goods from the EZ.

After several decades of research several theories have been developed regarding the relationship between ER and prices. To increase understanding of the main topic of this thesis it is important to have a clear understanding of the development and different approaches in economic literature regarding ER and tradable good prices and its impact on trade. The amount of literature is very extensive and still a lot of different views exist. The fact that views regarding these relationships have shifted continuously is also due to the fact of increased world market integration and increasing global trade. Also the rise of multinational enterprises (MNE) and the outsourcing of different stages of production to countries with cheap labour contributed to changing views of the relationship between ER and prices. Some of the theories that have been developed will be discussed briefly while others will receive greater attention depending on both the contemporary relevance and its relevance with the main topic. Because a chronological approach of theory development gives a better understanding of the subject at hand a good starting point is the MLC; named after Alfred Marshall and Abba Lerner.

*2.2 Marshall Lerner Condition*

The MLC provides a direct link between ER movements, prices and the balance of trade. This condition states that a devaluation of currency has a positive impact on the balance of trade given that the sum of price elasticity's of the export bundle exceed the absolute value of 1. Price elasticity's are therefore an important subject in exploring the link between ER movements and the trade balance.

The MLC can also be presented mathematically where the starting point is the equation below where European goods are used as a numéraire and capital accounts are not taken in to account:

$$CA(Q) = X(Q) - QM(Q) \tag{2.2.1}$$

CA stands for current account X stands for exports as a function of Q (the RER as explained above) and M stands for imports. As this equation makes clear changes in the CA occur due to changes in Q. This means that either the nominal ER changes or the price level in either the US or the EZ. As Q rises goods from the US become more expensive and to stay in equilibrium M has to decline and X will rise (the CA balance condition states X=QM).

Still this is not what empirics of the last decade show us and that is where, according to the MLC, price elasticity's come in to play. These are formulated as $\varepsilon_x$ and $\varepsilon_m$ the elasticity of export and import respectively. The elasticity's in the MLC condition are defined as $\varepsilon_x \equiv \frac{Q\,X'}{X} > 0$ and $\varepsilon_m \equiv -\frac{Q\,M'}{M} > 0$. Now taking the derivative with respect to Q which results in:

$$CA'(Q) = X'Q - QM' - M \tag{2.2.2}$$

(Dividing by M gives)

$$\frac{CA'Q}{M} = \frac{X'(Q)}{M} - \frac{-QM'}{M} - 1 \qquad (2.2.3)$$

Substituting the rearranged balance condition in the first term of  the right hand site (RHS) gives:

$$\frac{Q\,X'}{X} - \frac{Q\,M'}{M} \quad -1 \quad = \varepsilon_x + \varepsilon_m - 1 \qquad (2.2.4)$$

Now $CA'$ can only be greater than 1 if $\varepsilon_x + \varepsilon_m > 1$

This is a necessary condition under which an increase of the ER improves the CA. In the case of a European trade surplus, European goods are relatively cheaper than the goods from the US. To regain the sustainable equilibrium the ER has to change in order to balance relative prices. In this regard MLC therefore determines whether the equilibrium NER is stable or not (assuming constant relative price levels).

*2.3 Purchasing Power Parity*

This theory held well during periods of severely restricted capital flows as has been the case for currently developed countries. In the current financial and monetary environment however, capital is allowed to move freely across borders between developed economies and the theory does not seem to hold anymore. The theory of PPP has an absolute and relative version which will be denoted APPP and RPPP respectively.

The traditional PPP hypothesis starts with the Law of one price (LOP) which states that the price of traded goods between two countries (in absence of any trade impediments like tariffs and or transportation costs) should be the same when converted at the ER. This can be expressed as:

$$P_t^i = S_t P_t^{i*} \qquad (2.4)$$

$P_t^i$ denotes the price of homogenous good *i* and $S_t$ is the NER; the asterisk denotes again a foreign magnitude. When the equation would (temporarily) not hold for instance $P_t^i > S_t P_t^{i*}$ then it would be profitable to import good *i* which would eventually result in a rise of $P_t^{i*}$ and a fall in $P_t^i$ ; ending the arbitrage possibilities and restoring equilibrium. Summing all different *n* goods which are produced, where each good has its counterpart in the foreign country, obtains the average price level.

$$P_t = \sum_{i=1}^{n} \alpha^i P_t^i \qquad (2.5.1)$$

and

$$P_t^* = \sum_{i=1}^{n} \alpha^i P_t^* \tag{2.5.2}$$

The alpha term denotes the weight of good *i* used to aggregate individual prices i.e. $\sum_{i=1}^{n} \alpha_i = 1$ and assumed to be equal across both countries. The absolute version of PPP can be derived using these summation operators obtaining:

$$S_t = \frac{P_t}{P_t^*} \tag{2.6}$$

In other words APPP states that the overall price levels of the home and foreign country determine the NER. APPP is usually thought of as long run relationship after arbitrage has taken place. Another interesting notation to consider is equation 1.1; to get a PPP equation in RER terms instead of expressing in terms of the NER. Recall the equation: $Q_t = \frac{S_t P_t^*}{P_t}$ This now equals |1| when APPP holds. When taking logs on both sides of this equation it can be seen that the log of the RER equals zero.

$$q_t = s_t - p_t + p_t^* = 0 \tag{2.7}$$

An important implication of this outcome is that it undermines the theory of PPP itself. Remember that the correlation of the log between NER and RER is close to 1 and that the NER is quite volatile. The equation however states that the RER is not varying and that it would be independent of movements of the NER.

The RPPP is rather simple it just states that a country with relative high inflation rates will face a depreciating currency. This view is far less controversial than the APPP and is expressed in changes:

$$\Delta S_t = \Delta P_t - \Delta P_t^* \qquad (\Delta \text{ denoted first difference operator}) \tag{2.8}$$

*2.4 Mundell Fleming Model*

So far all theories that have been discussed regard ER as a relative price of commodities but other theories point to ER as an asset price rather than a commodity price. The asset approach of ER is a very different approach and will yield other ideas about both the behaviour and underlying fundamentals determining ER behaviour and its impact on trade. In describing the monetary approach, which can basically be divided in the flexible price monetary approach (FPMA) and the sticky price monetary approach (SPMA), the latter will be outlined.

In explaining the monetary approach the SPMA is used since it better serves the purpose of this thesis since it links ER and trade. For the purpose of describing the basic SPMA model the famous MFM, named after the economists Robert Mundell and Marcus Fleming (the former is a Nobel Laureate), is used. The MFM builds further on both PPP and the MLC and therefore continues to illustrate the evolution of economic thoughts regarding ER and the trade balance. The model provides an explanation for the volatility of NER, the effect of different shocks on the NER and its impact on trade.

The MFM captures some important features of monetary policy in altering equilibriums on both the goods –and money market. Central in this model are combinations of the NER and total output which lead to equilibrium and includes the well-known IS and LM curves. In short the IS curve represents all points where the combination of interest rates and income is in equilibrium with the goods market. The LM curve provides all combinations of interest and income which leads to equilibrium in the money market. Obviously these curves have opposite slopes since increasing output increase demand for money and interest rates have to rise to restore equilibrium whereas in the goods market a low interest rate will increase investment and therefore increase demand for goods.

In mathematical terms the IS curve can be presented as:

$$y = g + \gamma_1(s - p) + \gamma_2 y - \gamma_3 i \qquad \gamma_1 > 0, 0 < \gamma_2 < 1, \gamma_3 > 0 \qquad (2.9)$$

Where y is total output demanded which is influenced by government spending $g$, the income effect on consumption spending $y$ and the influence of the interest rate on consumption and investment is captured by $i$ . Finally the term $(s - p)$ reflects competitiveness and influences demand by its effect on net exports (which van be negative)

The LM curve is then given by:

$$m^D - p = \beta_0 y - \beta_1 i \qquad \beta_0 , \beta_1 > 0 \qquad (2.10)$$

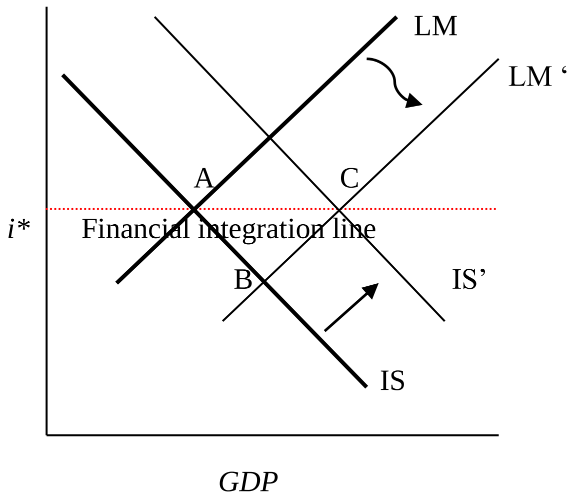
Here $m^D$ is money demand and $p$ again measures relative prices $\beta_0$ and $\beta_1$ are the income and interest elasticities respectively.

The last equation gives the condition for equilibrium in the balance of payments (BP)

$$b = \vartheta_0(s - p) + \vartheta_1 y + \vartheta_2 y^* + \vartheta_3 i + n \qquad \vartheta_0, \vartheta_2 > 0, \vartheta_1 < 0, \vartheta_3 \to \infty \qquad (2.11)$$

The first term measures the effect of the NER on the BP and the second and third term measure the effects of home and foreign income respectively. Finally $\vartheta_3 i$ measures the effect of the domestic interest rate on capital flows and $n$ an exogenous shift factor.

Graphically a monetary supply expansion can be presented with the figure below; which will also show the impact on the CA.




(fig. 1)

Assuming the economy is in its steady state at point A, the Central Bank decides to expand the money supply. This is illustrated by the shift from the LM curve to LM'. When a central bank increases the money supply, it will have a downward impact on the interest rate reflected by point B where the IS and LM' curve intersect. Because of the new and lower interest rate capital will flow out of the country and correspondingly the currency will depreciate. This will increase foreign demand for domestic goods and so the CA will improve. This is represented by the shift from IS to IS' in which the new equilibrium is in point C.

Further assumptions are sticky prices, a small country which takes world interest rates as given and perfectly elastic supply of imports for given prices in terms of foreign currency. Four different assets are assumed namely foreign and domestic bonds and foreign and domestic currency. Economic agents can hold foreign bonds but can't hold foreign currency. The fact that there is no situation of financial autarky is the essential difference of the MFM compared to the standard IS-LM model.

From equation 1.11 the effect of changes in the NER are obvious, a rise in the NER improves the BP and visa versa. In this sense it draws the same conclusions as all other theories already discussed but the conclusion has other fundamentals.

The models discussed so far does seem to provide some important directions about the relationship between ER and the trade balance but doesn't seem to be able explaining the empirics observed regarding trade between the EZ and the US. This is an important reason why a lot of criticism and doubt can be placed regarding the assumptions and conclusions of the models. The models are very static in its behaviour in the sense that markets shift to new equilibriums very quickly; if not instantly.

They also fail to incorporate some very important features in trade like transportation costs and the fact that world markets are not fully integrated so that arbitrage is not possible in the way the models assume. Other factors that violate PPP assumptions and the direct adjustment of prices are so called menu costs i.e. the costs involved in adjusting prices which arise by the need to print new catalogues for example. Furthermore the models discussed before fail to recognize the existence of imperfect competition and heterogeneity of tradable goods and the fact that not all goods domestically produced are traded goods.

Finally, assumptions regarding interest rates obviously violate reality in the sense that risk factors are not taken in to account. Different interest rates obviously do exist and won't lead to the assumed limitless capital flows the model predicts. Recent developments in the European bond market illustrate this once more.

### *2.5 Pricing to Market*

As mentioned more recent theories incorporate new assumptions about competition, dynamic versus static adjustments in economic models, pricing behaviour of multinationals and other factors that influence demand, ER and trade developments.

PTM actually is an upside down measure of ERPT and is therefore closely related with the concept of ERPT but additionally elaborates on market segmentation and thus multiple markets. A PTM coefficient of 0.55 means ERPT of less than one halve of the ER movement. The point of departure is that firms price their tradable goods based on the market structure of the trading partner and of course their own cost function. To make the difference between ERPT and PTM even more clearly assume the VS exports cars to both Germany and the Netherlands. Obviously consumers in both Germany and the Netherlands buy cars in exchange for Euros. Now suppose the USD depreciates 10% against the euro and before that depreciation Dutch and German consumer would both pay € 25.000,- for a car and after de USD depreciation a Dutch consumer pays € 22.500,- but a German consumer now pays € 20.000,- . In this case there are differences in ERPT between Germany and the Netherlands, full and negative respectively, which indicates pricing to market (ceteris paribus).

Regarding PTM and ERPT distinction can be made regarding the invoicing currency. Exporters can price their tradable goods in either their home or foreign currency. In the previous example this means that the US exporters of cars can invoice their prices to their European distributors in either USD or EUR. In the former case the pricing behaviour is called producer currency pricing (PCP) in the latter it is called PTM or local currency pricing[1]. When producers invoice in local currency and don't change their prices despite changes in the bilateral exchange rate it means zero pass through whereas producers invoice in their own currency (PCP) and don't change their price despite ER movements, full pass through is taking place. In all other cases partial pass through is at hand.

[1] Although some papers make a distinction between local currency pricing and PTM this thesis will arguable regard them as similar. This thesis will use the term PTM for indicating pricing in local currencies from now on.

The theory also shines a light on the structure of international markets and assumes the more modern approach that allows for imperfect competition and use a dynamic approach.

*2.6 Exchange Rate Pass Through*

In the mid-seventies the first alternative theories regarding ER and its link with trade emerged. One of those theories, which also will be used in the quantitative analyses later in this thesis, is exchange rate pass through (ERPT). A very important, if not the most important, difference is the micro economic foundation instead of the macro based models which have been discussed above; except for PTM. ERPT can be easily and shortly explained as follow:

*The extent to which a 1% change in a ER, in this case the EUR/USD, changes the consumer price of, again in this case, Euro Zone produced tradable goods in the VS.*

The phenomenon has several possible outcomes which are quite straight forward. Zero pass through is the case when the ER change has no influence on prices. Complete pass through is the case were the change in the ER is fully transmitted in prices. Next there is partial pass through which is observed many times in empirical studies. And there is the case of negative pass through when prices head the opposite way of the change in the ER.

As already mentioned short comings of previous theories are addressed like dynamic adjustments, the possibility of changing mark-ups and thus the possibility of imperfect competition. Although the As can be seen from the definition above the concept of ERPT is quite simple in its interpretation; the technical part is in testing the measure of ERPT which will be discussed later.

Unlike the theories outlined above there is no technical concept needed in explaining the theory of ERPT. In theory it is often suggested that ERPT can be measured as the change in mark up over marginal costs. There are several explanations behind this approach that exporting firms rather adjust their mark-up than to fully pass through exchange rate changes. Firms can take into account price elasiticities and choose to adjust their mark up in order to optimize their pricing policy; other explanations are menu costs or maintaining/expanding market shares.

## 3. Review of literature regarding ER and trade

*3.1 Introduction*

Before covering the literature of the theories outlined above it is important to distinguish between the Bretton Woods and post Bretton Woods era. There seem to be common believe regarding the effects of ER movements on trade in that ER volatility has a negative impact on trade flows. Since ER volatility increased six-fold Hallwood and MacDonald (2000) after abandoning the Bretton Woods system of fixed ER, the impact on world trade volumes should be obvious. Some researchers indicate this as one of the main reasons to form the European Monetary System (EMS) Grauwe (1988). Several theoretical and empirical studies confirm the negative correlation between ER volatility and trade volumes Rose (1991), Feenstra and Kendall (1991), Lee and Saucier (2005) and many more.

Other research claims opposite results like Viaene and de Vries (1992), Brada and Mendez (1988) and McKenzie and Brooks (1997). To make the ambiguity complete, several papers present mixed or insignificant results Gagnon (1993) and Kumar (1992) respectively. A more complete table which summarizes various studies regarding the effect of ER volatility on trade volumes can be found in the International Journal of Applied Econometrics and Quantitative Studies Vol.3-1 (2006) written by Ozturk, Ilhan (2006). Ozturk concludes, after a comprehensive literature study Ozturk, Ilhan (2006), that the majority of the papers show that increasing ER volatility has a negative impact on trade volumes.

*3.2 The Marshal-Lerner Condition*

The MLC is extensively covered in literature and even to this day researchers continue to investigate the validity of this long existing theory. The results, presented by existing literature, are very ambiguous as is shown for example in a paper by Ganesh S. Mani Srivyal Vuyyuri (2003). This paper provides, amongst other things, an extensive coverage of other research papers covering the MLC.

Although economic text books present the MLC as a widely acknowledged phenomenon empirical results are pointing in different directions, making it hard to draw firm conclusions about whether the MLC holds or not. Especially in the short- run the MLC does not always result in improved terms of trade, especially in the case of developed economies Bahmani-Oskooee and Malixi (1992). This negative effect is referred to as the so called J-curve effect and is widely documented in literature. One explanation for this effect is that prices are often sticky in the short run and that both producers and consumers have to adjust to the change in relative prices. Furthermore short-run import elasticity is mentioned as an important factor. The J-curve effect occurs if a country’s ER devaluation results in a short term deterioration of the trade balance after which the trade balance improves. The j-curve effect has however, also been observed in several OECD countries Boyd, Caporale and Smith (2001).

Now the question can be raised how the MLC performs as a reliable theory in the long run. A very accessible paper written by Paul Davidson provides a good starting. [2]

In his article, written for the journal of post Keynesian Economics, he investigates the effect, if any, of the declining USD on the US trade deficit. He starts with referring to earlier articles released like one published by Mann, (1999) regarding the same topic in which several economists and journalists state that the USD will automatically decline due to increasing trade deficits. Davidson, (2005) then gives an example that even with a declining USD the trade deficit doesn't have to decrease. He acknowledges that it indeed will most likely have its impact on trade volumes (both im –and export) but that price elasticity could result in an even wider trade deficit. Indeed, although the USD declined sharply against other major currencies the trade deficit grew during the period of 2002-2007. Now this period can hardly be seen as a short run period.

Another paper, written by A. Rose (1990), tests the hypotheses that the ER is NOT an important determinant of the trade balance in this model. By this model he points to the imperfect substitutes model (Rose, 1990). In the same article he further states: "economists are well aware that the 'Marshall-Lerner' conditions need not be satisfied". He examines this relationship with the 5 major OECD countries i.e. Canada, Germany, Japan the United States and the United Kingdom. But besides testing the effect of ER fluctuations on trade in the post Bretton Woods system he also tested the same hypothesis in during the Bretton Woods system in an earlier paper end again found no evidence of a strong relationship between both.

Obviously the MLC wouldn't be investigated anymore in economics if all research pointed to the same conclusion as did the authors of the articles above. H. Shirvani and B. Wilbratte (1997) use other measurement techniques to analyze the elasticity approach for the G7-countries i.e. the same countries Rose analyzed plus France and Italy. The key point in using different measurement techniques is that Shirvani and Wilbratte (1997) claim that one should use more recent cointegration techniques when analyzing non stationary data. Rose (1990) and others used the Engle and Granger (1987) approach like Shirvani and Wilbratte (1997) but the latter extended their analysis by using a method developed by Johansen-Juselius (1990) which they claim is more powerful[1]. They conclude that with the alternative measurements procedures the outcomes, in the long run, due comply with the MLC.

To complete the review of literature part regarding the MLC it is of great importance that, as Devereux (2000) mentions, the literature regarding CA has moved increasingly to an inter-temporal instead of an a-temporal approach. Depending whether prices are fully flexible or sticky one deals with either the a-temporal or inter-temporal condition respectively.

In the former case one should focus on elasticity of substitution of consumption in the latter the elasticity of substitution between foreign and home produced goods. These are obviously very different ways of approaching the same problem in which the inter-temporal way of approach makes

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[2] In their article they provide three reasons (page 43) in which they motivate their statement.

use of optimizing models and incorporates a monetary environment. Kenneth Rogoff and Maurice Obstfeld (1995) are generally considered as (one of) the founders of this new approach. In this regard Devereux (2000) concludes that the impact of currency devaluation seem to depend strongly on pricing behavior of MNE.

*3.3 The Mundell-Fleming model*

As already mentioned the MFM builds on the MLC in that a devaluation of a nation's currency improves the trade balance if the MLC is met. The emphasis in discussing literature regarding MFM will be on the effect of monetary policy in (artificially) improving the terms of trade by expanding the money supply to depreciate the currency. The early MFM literature studies the effect of monetary policy on output and the balance of payments (BOP) with the assumptions outlined in the theoretical part. Dornbusch (1976) was one of the first to relax the static assumptions which characterize the original MFM and incorporated expectations. In his famous and celebrated paper about ER overshooting he explains why under flexible ER regimes the deviations from the NER in comparison with the long run equilibrium ER take place because the asset market and money market adjust faster than the goods market.

Although this paper deserves attention it has little to do with the main topic of this thesis but the point is that recent literature still uses some of the basic foundations of the MFM but with accompanied with different assumptions. This part of the literature review will start with a useful overview of literature provide by Obstfeld (2001) and will end with Engel's paper Engel (2000). The main reason for the extensive treatment of the latter paper is that it includes assumptions regarding price rigidities and incorporate different ways of pricing i.e. producer –and local currency pricing. These assumptions are in line of reality in the way that firms use different invoice currencies and that for at least some traded goods prices are fixed in the short term; furthermore it incorporates several topics relevant to other subjects discussed in this thesis.

Obstfeld (2001) starts his paper with literature preceding the work of Mundell and Fleming (1968). Metzler (1948) and Meade (1951) already studied open economies and while Metzler repudiated the central role of the monetary system Meade linked the Keynesian system with monetary factors. Mundell extended Meade's emphasis on the monetary sector as is obvious from his theory discussed above. As already mentioned earlier all these papers must to a certain extend be viewed in the light of the economic reality of that time hence the Bretton Woods system.

In the late 1980's proponents of the new Keynesian approach relaxed the assumptions of perfect competition and incorporated imperfect competition in their models. Together with other assumptions regarding sunk costs and hysteresis economists tries to explain the persistence of international relative price movements. One of the first models was developed by Svensson and van Wijnbergen (1989) they incorporated zero MC and complete asset markets. Obstfeld and Rogoff (1995, 1996, 1998, 2000a) further developed these models adding more realistic assumptions like incomplete asset markets and sticky prices. The latest efforts are directed to international pricing behavior and more specifically PTM.

Engel (2000) incorporates PTM in such a way that one can use different degrees of PTM in bilateral trade. Because this paper treats all aspects of theories outlined above, this paper could be discussed under all headers of the literature part. Since it treats the effects of a devaluation of currency this paper is incorporated in the MFM part of the literature review.

In his model he uses *s* and s* for the measures of PTM of domestic and foreign firms respectively. These values range from 0 to 1expressing the percentages of PTM. In the case that $s = s^*= 0$, the LOP is maintained and hence, PPP holds[3]. In this case the prediction of the traditional MFM holds when the elasticity of substitution between home and foreign goods $\lambda > 1$ and the CA is affected by a-temporal considerations. In the other extreme case when $s = s^*= 1$ the devaluation will not alter relative consumer prices in both countries but it will increase the profitability of the home firms and therefore home income  due to increasing export revenues. Because of this effect the home country real income will rise and would improve the CA. Yet another crucial factor plays a role and that is the real interest rate. Because the real interest rates are not equated anymore since the home country real interest rate has fallen due to the devaluation. This results in an increase in home consumption and therefore all depends on the inter-temporal elasticity of substitution. Therefore the CA will be unchanged when $\omega = 1$ improves when $\omega > 1$ and deteriorates if $\omega < 1$. This means that when *s* and *s**are both between 0 and 1 the CA is effected by both a –and inter temporal effects.

Finally there is the case of asymmetric PTM, for instance s = 0 and s* = 1, the effect of a devaluation will depend on both $\omega$ and $\lambda$. Which effect of home country depreciation dominates depends on whether the intra -or inter-temporal effect dominates. When the intra-temporal effect dominates the CA will improve and visa versa in the situation that $\lambda < \frac{1}{\omega}$. There are also cases of *s* and *s** in which the effect on the CA is zero. Using the equations provided in the article it is possible to obtain a matrix of values of *s* and *s** in which all possible outcomes of this asymmetric situation are presented.

### *3.4 Purchasing Power Parity*

Central in the theory underlying PPP is whether relative price movements (for example, between traded and non-traded goods) are important in determining equilibrium real exchange rate movements Engel, (2000).

In the early 1920's and 1970's lots of research supported the idea of PPP and the monetary approach but again the floating ER regime led to the still dominant skepticism Dornbusch (1985).

[3] For a more detailed description of the model the reader is encouraged to study Devereux (2000) p. 841-847 in which he outlines the impact of an unanticipated devaluation on the current account under several circumstances.

Numerous academics have contributed in the literature regarding PPP and especially Jacob Frenkel made a bold statement in his survey stating that the PPP hypothesis had collapsed Frenkel (1980). Still other researchers continued to investigate the PPP hypothesis where they emphasized more on the long run implications. Kenneth Rogoff (1996) investigated this subject and compared the volatile short-term movements of the RER and its rather quick reconciliation and the slow mean reversion speed of the RER resulting in the so called PPP puzzle Kenneth Rogoff (1996).

The short term NER and RER volatility is often explained by portfolio effects, liquidity effects and speculative bubbles. A recent example is the big movement in the EUR/USD due to speculations about the creditworthiness of Greece and other Mediterranean countries and its impact on the value of the euro. Other models have been imposed incorporating variables which correct for transportation and or transaction costs but failed to provide a convincing support for the PPP hypothesis Aizenman (1984).

Engel (1998) took yet another effort to investigate the subject after recent work on PPP in high income countries seem to support the theory of PPP Frankel (1986), Kim (1990), Abuaf and Jorion (1990). In his paper he starts with the same equation presented above in the theory part of this thesis, hence equation 2.7[4](all variables in logs). He then decomposes the relative price levels of both the home –and foreign country in home and tradable goods:

$$p_t = (1 - \pi)p_t^T + \pi p_t^N \tag{3.1}$$

The foreign price level is presented identical but with asterisks denoted above the variable $p$ and parameter $\lambda$ instead of $\pi$. He continues by presenting the RER as

$$q_t = x_t + y_t \tag{3.2}$$

Here $x_t$ and $y_t$ are defined as traded and non traded goods respectively where both variables can further be decomposed as:

$$x_t = s_t + p_t^{T*} - p_t^T \qquad (s_t \text{ again denotes the NER}) \tag{3.3}$$

$$y_t = \lambda(p_t^{N*} - p_t^{T*}) - \pi(p_t^N - p_t^T) \tag{3.4}$$

Assuming the RER is non-stationary either $x_t$ or $y_t$ or both have to be non stationary as well. Since the vast majority of theory regarding international price determination implies that deviations from the LOP are stationary this leaves $y_t$, non traded goods, to be non-stationary.

[4] This section borrows heavily from Engel (1998)

The basic testing for unit root in time series is the Dickey and Fuller test Dickey (1976) Dickey and Fuller (1979). The objective of the test is to see whether a time serie is stationary or contains a unit root hence non-stationary. It can be presented by the following equation:

$$y_t = \emptyset y_{t-1} + u_t \quad (3.5)$$

$H_0$ : Series contain a unit root ($\emptyset = 1$).
$H_1$ : Series is stationary

Without elaborating to much on the methodology of this paper the null hypothesis tested in this paper, and others, come down to whether the relative price of non-traded goods has a unit root and determines movements of the real exchange rate in the long run. Engel concludes that even in the long run this is not the case and that PPP does not hold after all.

*3.5 Pricing to Market*

When reviewing literature regarding PTM it is hard not to incorporate one of the earliest, if not the first, paper mentioning PTM. Paul Krugman (1987), again a Nobel Laureate, found that ER changes between the US and European countries where not fully reflected in prices. He starts by making clear that the phenomenon above can also attributed to simple supply and demand dynamics. He illustrates this by an example of French wine exporters.

Suppose a USD appreciation which would make French wine cheaper to US consumers. This will most likely increase US demand which will, at least to some extend, raise prices so that the USD appreciation is offset partially by demand dynamics. If increasing demand is the only driver of the increase of the price the USD price will not increase relative to domestic or German export wine prices. Again it should be obvious that the result will also depend on demand/price elasticity's but these factors can be ignored without losing the general result this example offers. The main point is that one should separate demand dynamics from pricing behaviour related to ER changes. An example that does indicate PTM is the case where German car makers keep both domestic and USD prices constant despite an appreciating USD. In this case, the price of a car produced in Germany decreases relative to the price of a similar car sold in the US.

Krugman (1987) uses a very simple but rough method to estimate PTM coefficients. The example he uses to estimate PTM coefficients is based on unit values for manufactures. First he uses the actual unit value for US imports which rose 0.5% in the period 1980-1984. He also uses a predicted US import price, measured in USD, which is a weighted import unit value from Cananda, Japan, the European Community and other developed nations which fell 9.2% during the same period. The last step which is used for reference is to include the US manufactures export value which rose 21%. From the first two figures one could conclude that US import prices fell too little by 9.7%. He then divides this figure by the divergence between US and trading partner export prices; which is 30.5%[5] The value he obtains is 0.32 which is the measure of PTM of the RER movement. He uses several static and dynamic models and concludes that for understanding PTM one should focus on dynamic of imperfect competition. Furthermore he concludes that PTM does exist but does occur only in some markets and so PTM is not a general result. Still the existence of PTM in the sectors where it occurs is large enough to be reflected in aggregated data.

While the first papers regarding PTM mainly focussed on partial equilibrium models more recent research focuses on general equilibriums[6]. Knetter (1992) provides an interesting overview of literature regarding both PTM and ERPT and contributes to the literature by providing an empirical study of 7 digit industry trade again between Germany and the US. He finds evidence of PTM behaviour for German firms but not for the US.

Interesting studies referred to by Knetter (1992) are Mann (1986) who looks at 4 digit markets[7] and concludes that while US firms do not adjust, foreign firms are adjusting mark-ups to mitigate ER fluctuations. Large deviations of the LOP correlated with ER changes for Japanese manufactures are observed by Giovanni (1988). Other PTM research looked at similarities of PTM behaviour between different countries. Knetter (1992) tested the hypothesis that behaviour across industries in the US, UK, Japanand Germany was similar which could not be rejected. Only US industries, consistent with other studies Gangon and Knetter (1991), Mann (1986) and Knetter (1989) showed no PTM behaviour.

From a theoretical point of view two central questions are raised by Knetter (1992). First whether ER changes influence production costs set in domestic currency and second in what ways a change in the ER affects mark-up over costs. Although Frenkel (1992) treats these questions in his paper and provides strong arguments for answering both questions positively he does not mention them in his conclusion and does not empirically test them.

### *3.6 Exchange Rate Pass through*

Lots of literature exists regarding ERPT in which different aspects of ERPT are addressed. In this following part a selection of papers will be discussed. In selecting the papers the main goal is to stay as close to the subject of this paper as possible. Starting with papers that sketch a more general picture but which are necessary to discuss to gain a more complete understanding of the concept of ERPT and

[5] It is not exactly clear for the author of this thesis how Krugman obtains the value of 30.5 in this example. Even after calculating all possible percentage differences the value of 30.5 was not obtained. Regarding the value of the PTM coefficient however the author obtains the same value after rounding in two decimals.

[6] Examples from research in a partial equilibrium framework are (Dornbusch (1987) Knetter (1989). General equilibriums have been discussed by, amongst others, Chang and Devereux (1998) and Betts and Devereux (1996,2000)

[7] The term digit markets is used for markets/products defined by so called standard international trade codes (SITC)

ending with more detailed research which is more closely related to the problem formulated earlier in this thesis.

As already mentioned ERPT research started of in the mid-seventies. One of the early paper written by Kreinin (1977), Kreinin compared import prices of two different countries importing the same product from the US. For one of the two countries the ER remained unchanged compared to the USD for the other the ER changed. The change of the price for the imported good from the latter was attributed to the change of the ER and was used to measure the so called pass through coefficient (PTC). More recent studies use regression techniques to estimate the PTC.
A typical generic regression model used to obtain PTC's is often presented as:

$$p_i = \alpha + \delta X_t + \gamma S_t + \Psi Z_t + \boldsymbol{\varepsilon_t} \qquad \textit{(All variables are in logs)} \qquad (3.6)$$

This equation equals $p_i$, the price of an arbitrary product, to an intercept, three major components and of course an error term. $X_t$ is the primary control variable and is either a measure of price or cost and $S_t$ is the spot exchange rate. The control variable $Z_t$ can be used to incorporate variables that shift demand; for instance competing prices or income.

When the monetary system changed from fixed to floating ER regimes interest for ERPT grew. Earlier research was more focussed on the LOOP but with the introduction of ERPT scientists were provided with an equation which was based on behaviour. ERPT equations are also dynamic and took competing prices in to account as well as responses of prices to costs. In the beginning the main focus was to estimate aggregate PTC's for goods imported by the US. Different research outcomes seem to estimate a PTC of 60 percent Wing Woo (1984); Peter Hooper and Catherine Mann (1989).

After some research regarding aggregate PTC, and with further development of new theories in the field of trade and imperfect competition, scientists started to investigate industry specific PTC. Feenstra was one of the first to realize that for a monopolist the impact of a change in a bilateral ER should have a similar impact compared to a change of an import tariff Feenstra (1989). Feenstra investigated three separate markets; cars, small trucks and heavy motor cycles.
After incorporating the effect of an ad valorem tariff, real income in the US, a competing price for the import in the regression model (the $Z_t$ matrix) and finally some instrumental variables the estimation of ERPT ranged between 63 percent and 100 percent for trucks and motorcycles respectively. He also found that the estimation of the tariff pass through wasn't significantly different from his estimations regarding ERPT for al three industries.

Because the vast majority of papers indicated incomplete ERPT some researchers claimed this validated models of imperfect competition. At first sight it seems logical that incomplete ERPT implies changes in the mark up over marginal costs (MC) and thus imperfect competition. Unfortunately it is more complicated than this. In most regression models a certain cost index is used which is a good indication of average costs (AC). Industrial organisation however states that companies base their level of output on MC instead of AC. But there are additional complications in using cost indices since these indices are likely to result in measurement errors that are correlated with ER. Consider a German car producer selling Volkswagens to the US. Further consider the real mc function as a function of wages, output and imported input prices so the real cost function is $c^*$ and the used cost index is c. In this case V is a measurement error assumed that this cost index only depend on wages Goldberg and Knetter (1997).

$$c^*(w, q, m) = c(w) + V(q, m) \tag{3.7}$$

Now assume the EUR appreciates against the USD and that this will reduce MC because imported inputs remained constant in USD; this is a very reasonable assumption since most metals and raw materials are priced in USD. Another reasonable assumption is that the price of Volkswagens measured in USD will rise at least to a certain extend. This means that demand from the US will decrease and since the firm knows all this will change its level of output. This further implies that MC measured in EUR will fall; assuming MC rise with increasing levels of output Gron and Swenson, (1996). So both q and m are in this case affected by an appreciation of the EUR but this impact is not measured by the cost index. This means that the PTC, represented by $\gamma$ in equation 1.12 could very well be biased downwards meaning that the change of mark ups are overstated. Increasing globalisation of production processes also increase the risk of this kind of measurement errors Campa and Goldberg (1997). Since measurement errors in regression analyses are a certainty so are errors in estimating PTC. The main consensus however is that in most markets incomplete ERPT is the standard; exceptions are most commodities for instance (precious) metals.

Research has also focussed on the relationship between economic size and ERPT. Economic size seems to be related to ERPT in that sense that for instance, export prices of US exports are far less sensitive to ER fluctuations than for instance exports from Germany Knetter (1989). One reason for this relationship between country/market/economic size and ERPT can be found in international trade theory. Modern trade theory acknowledges that big countries can influence world prices since they have market power in both the seller and buyer markets.

Many other studies have been undertaken to explore reasons for differences of ERPT and factors that determine ERPT. Although one should be careful to interpret low ERPT as an indication of a (highly) competitive market, see equation 1.13 and the explanation of measurement errors, some researchers do conclude there is a clear connection between both at least in some markets (Kim, Cho and Koo, 2003). The point they make is that considering a flat demand curve i.e. a perfectly elastic demand where the price of a foreign firm is given by its competitors there is no mark up or market power. An appreciation of the bilateral ER in perspective of the foreign firm therefore cannot be passed through since in this situation of Bertrand price competition demand will reduce to zero. The strange thing in this reasoning however is that in this extreme and theoretical case any appreciation of the currency of the foreign firm would lead to zero exports because the mark up is zero and the firm will lose by selling its products below mc; given that the used materials for the product are not imported. In the other case it will drive the local competitors out of the market and become a monopolist. Still their reasoning provides a view that intuitively makes sense. It also shows that the literature is still divided regarding this topic.

To add further understanding to the phenomenon of ERPT it is also useful to know whether the PTC in general have increased, decreased or remained constant over time and if there is any connection between country size and PTC. Different researchers claim different results and even the same authors get different outcomes when investigating whether ERPT has changed or not. Different papers by Goldberg and Campa (2004), two scientists who are well known for their work on ERPT, are an example of the mixed outcomes that can be obtained. In their discussion paper of May 2004 about ERPT into import prices they state: "Out of the 24 OECD countries for which appropriate statistical tests could be performed, we confirm that there has been a tendency toward declines in ERPT rates". In a more recent working paper however Goldberg and Campa (2006) they state: "In this paper, we use cross-country and time series evidence to argue that retail price sensitivity to ER may have increased over the past decade". One can cast many doubts about the results of the first discussion paper since only 4 of the 24 OECD countries showed a significant decline in ERPT rates. More over 2 countries showed opposite developments leaving no less than 18 countries without any significant result.

In this perspective a better starting point could be to investigate which factors could result in changes of ERPT rates. Obviously a very important factor, when looking at aggregate ERPT rates, is the composition of imports/exports depending whether you reason from an importing or exporting country respectively. A shift from more homogenous products, like commodities, could lead to higher ERPT rates and vice versa in the case of high tech end products. In a recent paper this view seems to be confirmed by empirical results. Turkcan and Ates (2008) studied the trade of both intermediate and end products in the vehicle market. As expected they found higher PTC in the more homogenous auto part market than they found in the vehicle products market which is considered more heterogeneous. Both markets are very important markets since they have a large share in the US trade deficit Cooney and Yacobucci (2005). This is an important reason to include road vehicles in the quantitative analyses later on.

It is also important to recall the fact that due to globalization more components of end products are imported from everywhere in the world which could easily influence ERPT rates. For example a European car producer could import lots of vehicle parts from Asian countries and only build the cars at a local factory. This implies that only a small part of the production/marginal costs of the car is exposed to changes in the price of the EUR/USD. In the case of an appreciation of the EUR compared to the relevant Asian currencies this could even lead to a competitive advantage resulting in a lower price for European cars in the US because imported goods have become cheaper for European car manufacturers. To summarize the above a higher EUR/USD in combination with an even more appreciated EUR/Asian currency could also lead to the exact opposite and improve the balance of trade in favour of the EZ compared to the US.

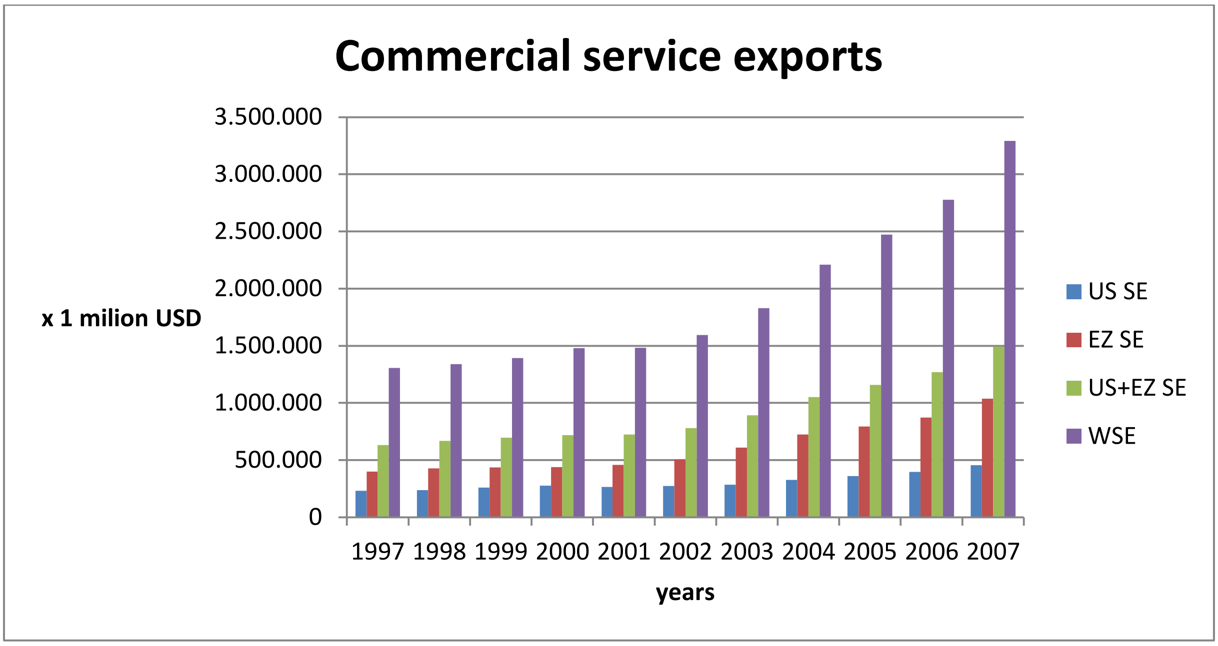
Obviously when talking about appreciating and depreciating currencies one is about to enter the world of monetary policies. Unfortunately monetary economics is again highly complicated territory but it is almost impossible to investigate ERPT without looking to monetary policies since central banks are able to directly influence the value of currencies. Central banks around the world have different targets and authorities but two of the most common targets are inflation targeting and stimulating the economy. Indeed the Federal Reserve Bank (FED) is responsible for both while the main task of the ECB is controlling inflation at 2% level to maintain price stability. Other central banks like the central bank of China have different targets. The Chinese central bank is accused by the US of keeping their currency artificially low to stimulate their export. Similar reasoning was mentioned in the introduction of this thesis by IMF managing director Dominique Strauss-Kahn to stress out the effects of the current ECB policy regarding the terms of trade of the EZ.

Without elaborating too much on monetary strategies, it is useful to see what the connection is between the value of currencies and ERPT. Theoretical research indicates that trading partners prefer to use the least volatile currencies as invoice currency Engel and Devereux (2001) and Bacchetta and van Wincoop (2002). In these papers it is also assumed that the same currencies are those with lower ERPT. Both findings are very interesting results with important implications regarding.
From this perspective it is interesting to compare ERPT between the US and individual members of the EZ before and after the formation of the European Monetary Union (EMU). Since the EMU has a very short history not much research has been done about the effects of the creation of a Monetary Union on ERPT. This is mainly due to statistical requirements since you need a certain amount of N data points before one can claim whether outcomes are statistically significant or not. Furthermore it is very important to investigate the foundation of the EZ and its possible impact on ERPT since it could shine a light on this sophisticated topic. Especially for research regarding PTM it is interesting to see whether prices of similar imported tradable products differ between different members of the EZ which would prove PTM; there seems to be convincing evidence for this to be the case.

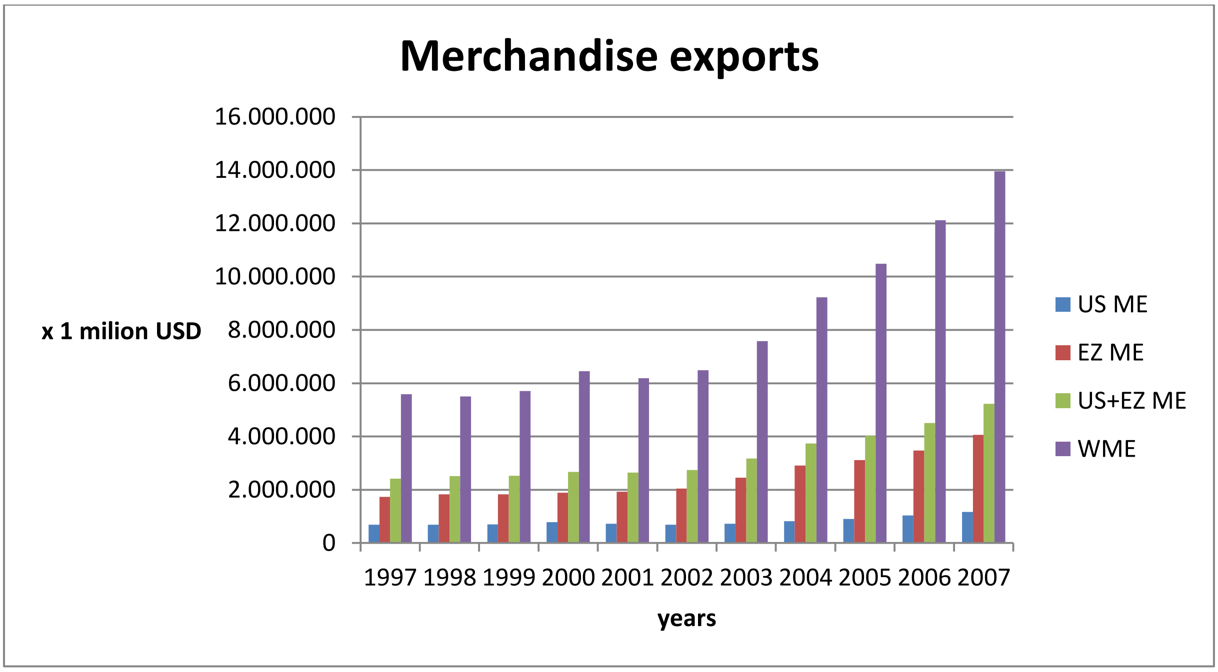
# 4. Testing exchange rate pass through for Eurozone exports towards the United States

*4.1 General features of trade and the EUR/USD exchange rate*

Before the three trade flows, mentioned earlier in our introduction, will be investigated a short context is provided regarding international trade and the development of both the EUR/USD and the NER and RER of the same currencies. As can be seen from the graph below, world trade in both merchandise and commercial services more than doubled in ten years' time[8].




*(source: WTO international trade statistics 2008)*

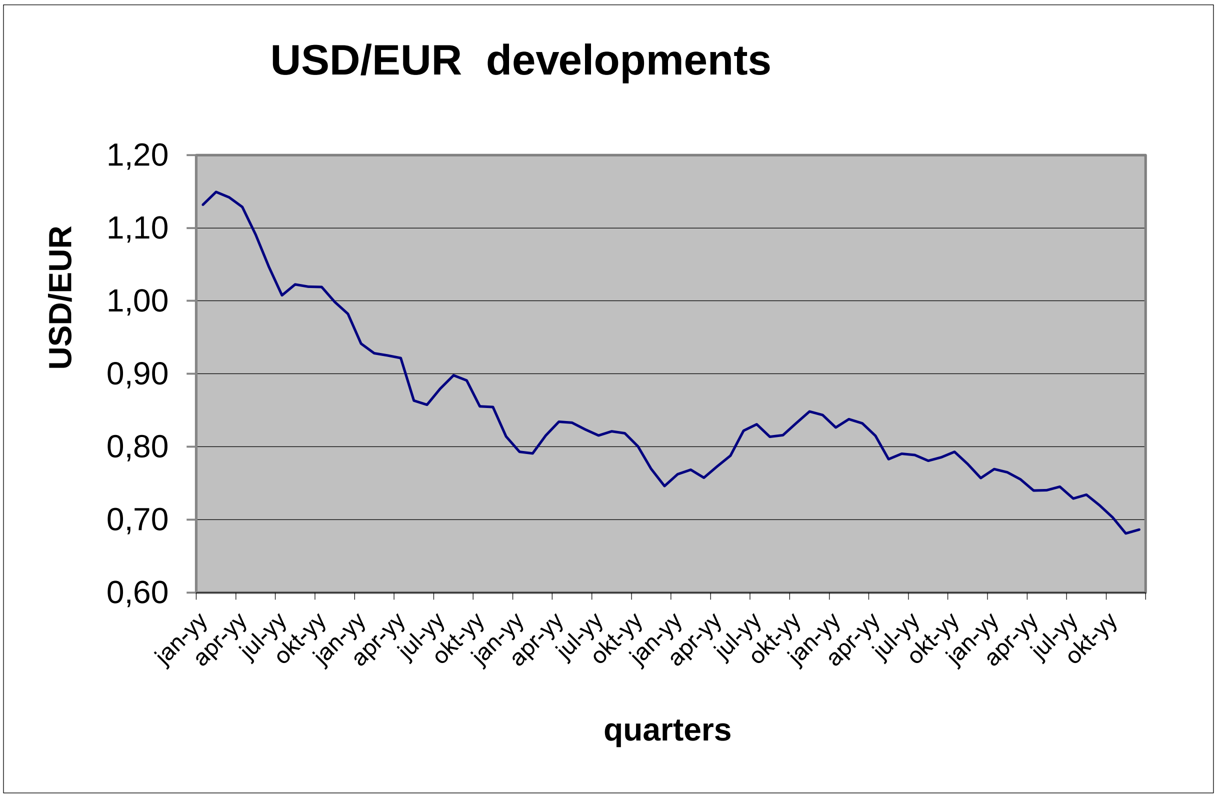



*(source: WTO international trade statistics 2008)*

[8] The euro zone in this case are the first twelve member

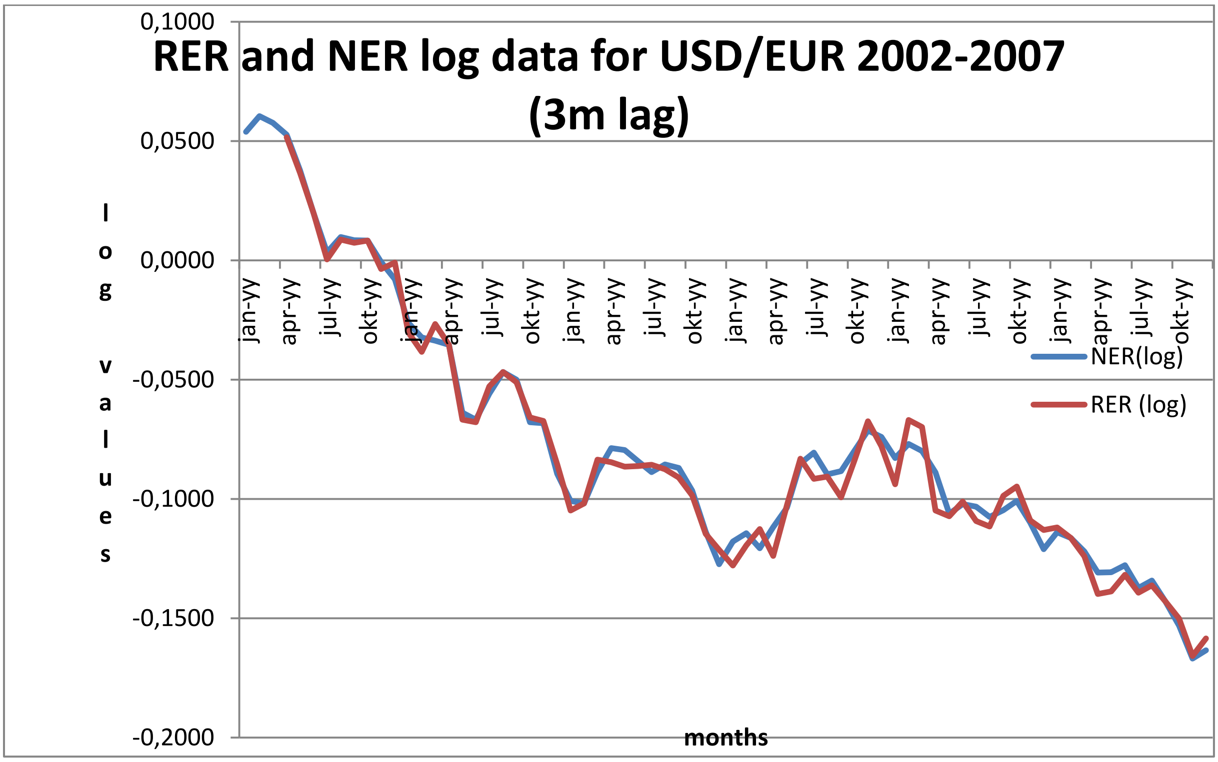
Although slowly declining, the US and the Eurozone still account for a very large share of these trade flows. Furthermore one can see that merchandise trade is still the most important component in world trade.

The last two graphs preceding the analyses, which is the main goal of this section, show the development of both the EUR/USD plus the nominal and real exchange rate expressed in logarithms. The graph shows a clear upward trend over the period of interest obviously implying a continuous appreciation of the EUR against the USD.




*(source: Euro stat)*

The second graph depicts the close relationship between the NER and RER during the same period as the previous graph. This result is compliant with empirical findings in literature. The standard result of estimating the correlation coefficient of the natural logarithms between NER and RER of developed countries is around 0.9 Mussa (1986) for the short run i.e. a lag of 3 months. The RER in this graph is the NER corrected for consumer price indexes of both the Eurozone and the US. This is an important finding since a large deviation would complicate the analyses since this deviation itself could be the reason for the seemingly lack between the development of exchange rates and good prices instead of pricing behaviour of multinational enterprises.




*(Source: Eurostat; RER is NER corrected for HICP)*

*4.2 The Model*

The model that will be used to estimate the ERPT coefficients of the three trade flows under investigation has been developed by Goldberg and Campa (2002). The reason for choosing the model developed by Goldberg and Campa (2002) is that it is one of the more recent developed methods of estimating PTC and is used widely in ERPT studies; amongst others Landau and Skudelny (2009), Turkcan and Ates (2008) and Oladipo (2007). Furthermore it incorporates several important independent variables that correct for other factors which influence import factors as explained below. Finally the model is easy to use and easy in its interpretation. Their model can be classified as a mark-up model which means that the estimate of the exchange rate pass through coefficient is measured as the change of the mark up over marginal costs. The price is presented as[9]:

$$PX_t^{vs} = \pi_t^{vs} C_t^* \tag{4.1}$$

Where the exporting firm sets the price in its own currency, in this case the euro, $(PX_t^{vs})$ as a mark-up $(\pi_t^{vs})$ over its marginal costs $(C_t^*)$; here the asterisk represents that the variable is measured in the currency of the exporter. The import price measured in the importers currency $(PM_t^{vs})$ is obtained by

[9] The standard notation is *j* instead of *vs* since most empirical studies test for several countries; in the standard case *j* denotes the country to which the price setting exporting firm sells its goods. The author uses *vs* to try to make the model and analysis as clear as possible.

multiplying equation 4.1.1 with the foreign exchange rate ( $E_t^{vs}$) (defined in this case as the price of one euro in terms of the USD.

The following equation is obtained:

$$PM_t^{vs} = (PX_t^{vs})E_t^{vs} = (\pi_t^{vs})\, E_t^{vs} C_t^* \qquad (4.2)$$

The model assumes that if ERPT is incomplete the mark up rate ($\pi_t^{vs}$) will vary. Obviously there are more factors that influence mark up rates and the model tries to incorporate those factors by adding additional variables that define the mark up rate. Adding those variables the mark up (profit) is modelled as:

$$\pi_t^{vs} = \left(\frac{P_t^{vs}}{E_t^{vs} C_t^*}\right)^{\alpha} \left(Y_t^*\right)^{\beta} \qquad (4.3)$$

Mark up rates depend on demand pressure $Y_t^*$, competitive pressure $P_t^{vs}$ and the exchange rate $E_t^{vs}$. Because of the increase of imported intermediate goods used for the production final goods the exchange rate can be an important cost factor. Demand pressure is captured by using the exporting country's industrial production index (IPI) and the competitive pressure with the price of import competing products. Equation 4.3 is plugged into equation 4.2 to obtain (after rearranging terms):

$$PM_t^{vs} = (E_t^{vs} C_t^*)^{1-\alpha} (P_t^{vs})^{\alpha} (Y_t^*)^{\beta} \qquad (4.4)$$

Denoting this equation in logarithmic form yields:

$$pm_t^{vs} = (1-\alpha)e_t^{vs} + (1-\alpha)c_t^{vs} + \alpha p_t^{vs} + \beta y_t^{vs} \qquad (4.5)$$

One can see from the equation that the coefficient of the exchange rate and foreign costs are equal which does not have to be the case in practice. The final equation used to estimate the PTC allows these coefficients to differ. We finally obtain:

$$pm_t^{vs} = \alpha + \beta_1 e_t^{vs} + \beta_2 c_t^* + \beta_3 p_t^{vs} + \beta_4 y_t^* + \varepsilon_t \qquad (4.6)$$

This equation will be used to estimate the exchange rate pass through coefficients for road vehicles (SITC 78), petroleum related products (SITC 33) and medicinal and pharmaceutical products (SITC 54). There are several reason for transforming the model, hence equation 4.4, to a logarithmic scale. First one can see from equation 4.4 that the model is multiplicative which means that the different variables in the equation are multiplied instead of separated in different terms. While a model with powers of the $X_j$ variables still keeps the model linear, powers of the coefficients $\beta_i$ make the model nonlinear.

A general form of a multiplicative regression model is:

$$Y = \beta_0 X_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3} \epsilon \qquad (4.7)$$

The implication is that the multiplicative model, as presented above, cannot be fitted using linear regression techniques since again the model is nonlinear i.e. yielding power curves. Besides this obvious reason to transform the model into a linear model by logarithmic transformation, there are other advantages of using variables on a logarithmic scale. This will be outlined later in this section which will discuss the data and econometric procedures.

*4.3 The Data*

This study will approximate import prices $pm_t^{vs}$ by using import unit values from the eurostat database (http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database). Unit import values are obtained by dividing the monthly EZ export values measured in EUR by the corresponding monthly quantities (kilo grams) and converting into USD. This implicitly assumes that the composition of trade does not change over time which in practice will obviously not be the case. Still it serves as a good approximation and adjusting the data to match the exact characteristics of the trade flows is obviously too cumbersome. The monthly average exchange rate is obtained from eurostat (http://epp.eurostat.ec.europa.eu).

All other data will be drawn from the International Financial Statistic Database (IFS) provided by the International Monetary Fund (IMF). IFS provide producer price indexes of both the EZ and the US which will be used as a proxy for $c_t$ and $p_t$ respectively. Finally $y_t$ is approximated by the Foreign Industrial Production Index (IPI). The data for the EZ is obtained by retrieving data for each individual founding member. The reason is that current Eurozone data consists of data with additional member states which will result in a bias within the data. One difficulty is that PPI data from Luxembourg is not similar with data from other EZ members. Other problems with data from Luxembourg are missing values and different base years for all indexes. First the data was not provided by the IMF but after correspondation, data was provided. Still the data does not include some industries that other EZ producer price indexes (PPI) do cover.

The author chooses to exclude the data in order to work with comparable and similar data without missing values. Since Luxembourg production volumes have a negligible share in total EZ production volumes (for all three product groups under analyses) the impact on the final results will be extremely limited and therefore considered acceptable by the author.

The eventual Eurozone PPI figure will then be obtained by weighting the 11 different monthly PPI figures of each member state by their percentage share of total monthly EZ exports in the three different product groups.

This means that if country A in a specific month has a share of 60% in that total monthly EZ SITC 33 exports the PPI index of the same month will consist for 60% of country A's PPI value. In obtaining and retrieving import data for the U.S. no problems occurred.

*4.4 Econometric procedures*

To explain the additional advantages of logarithmic transformation it is useful to have a close look at the properties of the variables under investigation. It is widely believed that a vast majority of time series in business and economics behave according to stochastic processes. A stochastic process or stochastic variable is also called a chance process or variable respectively. This means that obtained values of the depended variables, $y_1, y_2, y_t$ etc, are drawn randomly from a probability distribution. Furthermore it is very likely that at least some of the variables in this regression model will behave as non-stationary i.e. whose statistical properties such as mean and variance are not constant over time[10]. To obtain meaningful test results it is therefore important to transform non stationary data into stationary data. The first tests that will be run is whether the time series data is indeed non stationary or if the series are stationary after all. The tests that will be used are the Augmented Dickey –Fuller, Phillips-Perron and the Kwaitkowski test. The first two methods test the hypothesis:

$H_0$: $y_t \sim I(1)$

$H_1$: $y_t \sim I(0)$

Kwaitkowski tests the hypothesis:

$H_0$: $y_t \sim I(0)$

$H_1$: $y_t \sim I(1)$

The first two tests, test for a unit root while Kwaitkowski tests for stationarity. Combining these tests is known as confirmatory analysis and enhances the power of the conclusion if all three tests reach the same conclusion.

The *I* stands for the level of integration of the variables. Other test could be used to test for higher orders of integration but the majority of financial and economic data contains one unit root and therefore has to be differentiated once to obtain a stationary serie. The process of differentiating is a

[10] When running the regression there will be tested for stationarity according to the hypothesis following equation 3.5; for now non stationarity is assumed to explain further data procedures.

common way of obtaining stationary series when the original series are non stationary; this process can be explained as follows.
Consider a simple non stationary process like the equation below better known as the random walk:

$$y_t = y_{t-1} + \epsilon_t \tag{4.8}$$

It states that each successive change in $y_t$ is drawn from an independent probability with 0 mean[11]. With a random walk process one of the main problems is that both the variance and covariances becomes infinite. The variance of the random walk process is shown in the equations below.

$$\gamma_0 = E(y_t^2) = E[(y_{t-1} + \epsilon_t)^2] = E(y_{t-1}^2) + \sigma_\epsilon^2 \tag{4.9}$$
$$= E(y_{t-2}^2) + 2\sigma_\epsilon^2$$

.

.

$$\gamma_0 = E(y_{t-n}^2) + n\sigma_\epsilon^2 \qquad \text{(general form)} \tag{4.10}$$

As can be seen the value of $y_t$, as is presented in equation 4.8, is substituted into equation 4.9. Indeed if *n* gets large the last term tends to infinity.[12] To avoid these problems the method of first differencing can be used to obtain series which behave stationary. The process of differencing can be done more times than one if necessary. If a serie becomes stationary after differencing one time the serie is first-order homogeneous non stationary. The result of differencing equation 4.8 is shown below:

$$w_t = \Delta y_t = y_t - y_{t-1} = \epsilon_t \tag{4.11}$$

Now $w_t$ has become a stationary process since the error terms $\epsilon_t$ are assumed to be independent over time. In practice it is difficult to decide how many times one should difference the time series under investigation. A useful tool is to have a look at a correlogram, i.e. a plot of an autocorrelation function.

The (sample) autocorrelation function is a measure of the correlation between neighbouring data points in this case $y_t$ and $y_{t-1}$; the estimator of the autocorrelation (AR) with lag *k* is ρ 'head'[13]. The value of $\rho$ ranges between zero and one and is one in the case if one measures the AR of $y_t$ on $y_t$ (no

[11] The following explanation uses the approach of the 4th edition of the book econometric models and economic forecasting by R. Pindyck and D. Rubinfield, (1997) McGraw-Hill, chapter 16.1.2. The same source will also be used for explaining the process of differencing non stationary data.
[12] The process and theory regarding the covariances will not be explained since the purpose of this thesis is not to provide an extensive overview of econometric theory. If the reader is interested in understanding this process the author refers to chapter 16.2.1 of the book mentioned in foot note 11.
[13] Again the mathematical derivation and theory regarding the autocorrelation (AR) function will not be explained for the same reason as mentioned in footnote 12. Further more ρ 'head' , which is commonly used as a symbol for the sample AR, will from now on be presented as ρ since the micro office word does not provide this symbol.

lag *k*). High values of $\rho$ indicate non stationary series. In a correlogram non stationary series are shown as a value of $\rho$ that does not decline with increasing values of *k* lags. A rule of thumb is to difference the regression equation until the value of $\rho$ equals or is close to zero. When testing the individual series for unit roots and stationarity the Eviews output table also provides the Durbin Watson statistic which tests for auto/serial correlation. The Durbin Watson value ranges between 0 and 4 where 2 indicates no autocorrelation 0 indicates strong positive autocorrelation and 4 strong negative autocorrelation.

After testing for (non) stationarity of the series a test for multi cointegration will be executed to see whether differences exists between the data series regarding the cointegration relationships. In this case the two step Engle-Granger method will be used[14]. With this method an equation is first estimated in Eviews which can be tested for cointegration. The cointegration regression is estimated using fully modified ordinary least squares (FMOLS) following the Akaike criterion, which shows the goodness of fit of the model and then the parameter values are estimated. Then the saved residuals will be tested to ensure they do not contain any unit root. The null hypothesis states no cointegration relationship is detected and indicates a poor predicting model since the variables do not seem to move together over time. The probability values provided in the estimated cointegration relationship test the null hypotheses of the coefficients not being significantly different from 0. The next section will show the results of all the tests discussed above.

### *4.5 Results*

This section will provide a summary of the results obtained with the estimation procedures in Eviews. In the Appendix all the obtained output tables will be provided for the reader who is interested for a more detailed understanding of the outcomes. Although a rule of thumb in time series states that a sample should at least contain 60 observations to claim statistical significant outcomes, results obtained from a total of 75 observations still needs to be treated with some caution.

Before presenting the results the expected outcomes for the variables will be discussed. Based on existing literature and common economic thinking we would expect the PPI for the EZ to have an increasing effect on US import prices since it is highly likely that at least a part of the rise in production costs for the EZ will be transferred to export prices. The expected influence of a rise in the PPI of the US is less straight forward and depends heavily on (pricing) strategies of exporting firms from the EZ. If European priorities lie in increasing their market share they could keep their prices constant or increase prices modestly.

The exchange rate is expected to have an increasing effect which means that a decline in the value of the USD/EUR ER will increase import prices. Finally the IPI is expected to have a decreasing

[14] Since Pindyck and Rubinfield do not provide theory regarding multiple cointegrating relationships in their text book this explanation borows heavily from Introductory econometrics for finance Brooks, C. (2007) Cambridge University Press Chapter 7.

effect on US import prices since it reflects supply of goods hence increasing supply should lead to decreasing prices following standard economic intuition and thinking.

Below the results for the first series of tests are shown. All variables are tested for unit root and the results are shown below:

Unit Root and Stationary tests

| Test | Augmented Dickey Fuller (ADF) | Philips-Perron (PP) | Kwaitkowski (KPSS) |
|---|---|---|---|
| NER | -1.797340 (0.6992) | -1.797340 (0.6992) | 0.207604** |
| IPIEZ33 | -8.293427 (0.0000) | -17.45130 (0.0001) | 0.295737*** |
| IPIEZ54 | -9.129104 (0.0000) | -11.36681 (0.0000) | 0.50000*** |
| IPIEZ78 | -7.905823 (0.0000) | -7.698220 (0.0000) | 0.157645** |
| PM33 | -3.525699 (0.0439) | -3.525699 (0.0439) | 0.085851 |
| PM54 | -7.127426 (0.0000) | -7.136922 (0.0000) | 0.149795** |
| PM78 | -2.872572 (0.1774) | -3.776825 (0.0233) | 0.205474** |
| PPIEZ33 | -2.745634 (0.2221) | -2.738476 (0.2248) | 0.244010*** |
| PPIEZ54 | -2.041251 (0.5692) | -2.064017 (0.5568) | 0.216121*** |
| PPIEZ78 | -2.017485 (0.5820) | -2.268561 (0.4453) | 0.213633*** |
| PPIUS | -3.879132 (0.0179) | -3.613043 (0.0355) | 0.104948 |

Notes: The values without parentheses are critical t-values while the values in parentheses indicate the probability that H0: series contain a unit root, holds. The asterisks in the final table indicate the level of reliability that HO: series are stationary, can be rejected with *,**,*** mean 90%, 95% and 99% reliability respectively

The obtained results are rather confusing since several outcomes seem to be in sharp contrast with each other. For example the variable IPIEZ33 does not seem to have a unit root while the KPSS statistic strongly indicates a non-stationary serie. This would mean that a serie can be non-stationary while is does not contain a unit root; the same observations are observed for all Industrial Production Indexes (IPI) series. The same sorts of problems arise with the variables PM54. The results for all Producer Price Indexes do provide consistent outcomes as do the results for the exchange rate.

Although the results are difficult to interpret these findings are not totally uncommon in literature see Turkcan and Altes (2008) where they don't find unit roots for some depended variables (import prices). In this case the author chooses arguably assumes non stationarity for all series since it goes beyond the econometric knowledge of the author to test equations with both stationary and non-stationary results.

The argument for assuming non stationary series leans on the common finding in economic literature that the majority of economic variables behave as non-stationary over time Nelson and Plosser (1982), Campbell and Mankiw (1987) Gardner and Kimbrough (1989). The other argument is that the results from the KPSS test reject stationarity for the majority of the variables

Durbin Watson, Philips-Perron and Kwaitkowski Statistics

| Test | Augmented Dickey Fuller (ADF) | Philips-Perron (PP) | Kwaitkowski (KPSS) |
|---|---|---|---|
| NER | 1.840655 | 1.840655 | 0.148641 |
| IPIEZ33 | 2.114562 | 2.006791 | 1.946692 |
| IPIEZ54 | 2.094518 | 1.959129 | 1.843152 |
| IPIEZ78 | 2.090526 | 1.967762 | 1.756820 |
| PM33 | 1.776535 | 1.776535 | 0.589988 |
| PM54 | 2.053501 | 2.053501 | 1.629192 |
| PM78 | 2.004819 | 2.375727 | 0.665769 |
| PPIEZ33 | 2.040409 | 2.040409 | 0.145821 |
| PPIEZ54 | 1.947480 | 1.947480 | 0.128906 |
| PPIEZ78 | 1.976377 | 1.616382 | 0.076792 |
| PPIUS | 1.939930 | 1.725484 | 0.504045 |

All DW values are obtained from the output tables provided by the unit root and stationary tests above.

While all the values obtained from the unit root tests indicate no or negligible auto correlation the values obtained with Kwaitkowski show strong positive autocorrelation in many cases. Again the author has troubles with interpreting these results. Since a decision whether autocorrelation is present or not has to be made, and further testing will not be undertaking, the author again arguably assumes no autocorrelation present in the data series[15].

Next the results for the test of presence of cointegration using the 2 step Engle-Granger method are presented. This method can only be applied after estimating the equation by means of a cointegration equation using Fully Modified Ordinary Least Squares (FMOLS) but the results will be given prior to the results obtained from running the equation.

[15] The author both realizes and regrets the rather strange outcomes which force the author to make bold assumptions regarding the behavior of the data under investigation. Still the author has followed the procedures suitable for testing on unit roots, stationarity and auto/serial correlation.

Cointegration tests for all Equations

| Equation | No lags | P-value | 3 lags for NER | P-value |
|---|---|---|---|---|
| SITC 33 | NC | 0.1203 | C | 0.0213** |
| SITC 54 | C | 0.0000*** | C | 0.0000*** |
| SITC 78 | C | 0.0000*** | C | 0.0131** |

H0 = series are not cointegrated *,**,*** indicate rejection of H0 on a 10%,5%,1% significance level respectively C stands for cointegrated NC for not cointegrated.

The results show that cointegration between the variables is present in 5 of the 6 equations estimated. This means that cointegration in present in all estimated equations for which a lag of 3months for the NER is included. The outcomes of the estimated coefficients for all the models where cointegration is detected can therefore be seen as the final outcomes.

Finally the equation is estimated using FMOLS. Each equation is run twice; with no lags and 3 lags for the variable NER i.e. USD/EUR real exchange rate. The three tables below will show the results:

Equations SITC 33

| Model | No lagged coefficient | P- value | 3lags for NER coefficient | P- value |
|---|---|---|---|---|
| NER | 0.081378 | 0.7497 | 0.396458 | 0.1199 |
| IPIEZ33 | -0.202022 | 0.3555 | -0.171443 | 0.3737 |
| PPIEZ33 | -0.356575 | 0.7938 | -0.576543 | 0.6640 |
| PPIUS | 4.736229 | 0.0000*** | 5.095783 | 0.0000*** |
| C | -15.44324 | 0.0000*** | -16.15227 | 0.0000*** |

For all estimated coefficients the HO: The coefficients are not significantly different from 0, is tested against the alternative that the coefficients are different from zero. Again the asterisks indicate *,**,*** indicate rejection of H0 on a 10%,5%,1% significance level respectively

Equations SITC 54

| Model | No lagged coefficient | P- value | 3lags for NER coefficient | P- value |
|---|---|---|---|---|
| NER | -0.974566 | 0.0530* | -0.879703 | 0.1209 |
| IPIEZ54 | -0.696540 | 0.1453 | -0.468380 | 0.3156 |
| PPIEZ54 | 8.739898 | 0.0001*** | 8.697289 | 0.0004*** |
| PPIUS | -2.943096 | 0.0454** | -2.945076 | 0.0836* |
| C | -12.78124 | 0.0027* | -13.59120 | 0.0017*** |

For all estimated coefficients the HO: The coefficients are not significantly different from 0, is tested against the alternative that the coefficients are different from zero. Again the asterisks indicate *,**,*** indicate rejection of H0 on a 10%,5%,1% significance level respectively

Equations SITC 78

| Model | No lagged coefficient | P- value | 3lags for NER coefficient | P- value |
|---|---|---|---|---|
| NER | -0.691943 | 0.0000*** | -0.518242 | 0.0000*** |
| IPIEZ78 | 0.206263 | 0.0008*** | 0.258348 | 0.0135** |
| PPIEZ78 | -0.684456 | 0.0421** | -0.963123 | 0.1153 |
| PPIUS | -0.176627 | 0.4225 | 0.104411 | 0.8012 |
| C | 10.35848 | 0.0000*** | 10.15890 | 0.0000*** |

For all estimated coefficients the HO: The coefficients are not significantly different from 0, is tested against the alternative that the coefficients are different from zero. Again the asterisks indicate *,**,*** indicate rejection of H0 on a 10%,5%,1% significance level respectively

As can be seen the results of all 6 estimated equations differ between both the product groups and whether a lag is included for the NER. Again the results are disappointing when the goal is to confirm convincingly the existence of ERPT since only 3 equations show that the NER coefficient is significantly different from 0 in this case. Only the final equation indicates strong evidence for the influence of the NER i.e. the case of road vehicles (SITC78). For pharmaceutical products (SITC54) we only find some evidence in the case where no lags are included. The equation which tests for presence of ERPT in the case of petroleum related products (SITC) shows no sign of presence of ERPT. However the PPI of the US seems to significantly influence the import price for petroleum related products. A possible explanation for this could be the fact that one of the main factors for driving the costs of petroleum related products is obviously oil. Since oil is denominated in USD European export prices contain for an important part production costs invoiced in USD. This decreases the likelihood that ERPT can be filtered out from other cost and currency developments and be measured. The PPI of the US seems to have an upward pressure on US import prices. A reason for this effect could be that European exporters want to profit from rising prices in the country which they export to.

In the case where the NER does seem to influence US import prices the direction of the coefficient looks somewhat surprising at first sight. It seems to indicate that a lower value of the USD/EUR exchange rate has a negative effect on US import prices for road vehicles; hence a weaker dollar results in lower US import prices. One should keep in mind however that the logarithm of the NER, hence the independent variable itself, is negative in absolute value so multiplication of two negative values obviously results in a positive value. This makes far more sense intuitively so in fact incomplete pass through is measured and observed which is consistent with the vast majority of outcomes in corresponding literature.

Looking at the IPI figures again only the equation for SITC78 show that the coefficients are significantly different from zero therefore the weighted industrial production index does not seem to significantly influence the import prices for both petroleum related –and pharmaceutical products. The IPI coefficient is positive conform the models expectations.[16] An explanation for this is that increasing demand is reflected by increased production and increasing prices. The rest of the insignificant coefficients will not be discussed since they have no explaining power regarding European export prices.

Finally the explaining power of all three models will be investigated by looking at Adjusted $R^2$ i.e. a measure of how well future outcomes are likely to be predicted by the model. It gives some information about the goodness of fit of the model by measuring how well the regression line approximates the real data points. Also the Akaike information criterion will be shown which gives an indication of the goodness of fit of the model as explained above. Since a value that ranges between 1 and 2 indicates that inferences can be made and therefore have substantial support while a value between 4 and 7 have substantial less support

| Equation | Adj. $R^2$ | Akaike info criterion |
|---|---|---|
| SITC 33 | 0.957803 | -2.466052 |
| SITC 33 (3 lags) | 0.958417 | -2.511970 |
| SITC 54 | 0.504186 | -0.223364 |
| SITC 54 (3 lags) | 0.506469 | -0.252777 |
| SITC 78 | 0.830710 | -4.352190 |
| SITC 78 (3 lags) | 0.538277 | -3.651435 |

As can be seen some of equations have a very good fit i.e. SITC 33, SITC 33 with 3 lags and SITC 78. The other equations seem to explain around 50% of the variation of the import prices is explained by the 4 independent variables. The Akaike information criterion results seem to indicate that the majority of the models estimated have good fit. With only the 2 equation estimating the import price developments of products under SITC78 having an arguable goodness of fit but are neither useless in making precautions inferences.

Overall the results are not always convincing but neither useless at all. The estimated models seem to fit the data quite well and some equations in which we several parameters have been found that significantly influence the dependent variables.

[16] As Turkcan and Ates (2008) state in their paper: the competitive pressure and the demand pressure variables are expected to be positive.

## 5. Conclusions and suggestions for further research

The aim of this thesis was to investigate the impact of the devaluating USD against the EUR and its impact on the terms of trade for the Eurozone and further to estimate the ERPT for three major Eurozone export flows towards the United States. The approach included several important economic theories that are developed to explain the expected outcomes of a situation as mentioned above. Based on the literature the only strong conclusion that can be made seems that  there is still a lot of debate about the validity of economic theory regarding the topic under investigation. It therefore can be stated that there is no golden rule regarding the expected impact of trade developments in a situation where one country's currency depreciates against a trading partner and their bilateral trade volumes. In this regard the reasoning of now former IMF managing director Dominique Strauss Kahn is to straight forward.

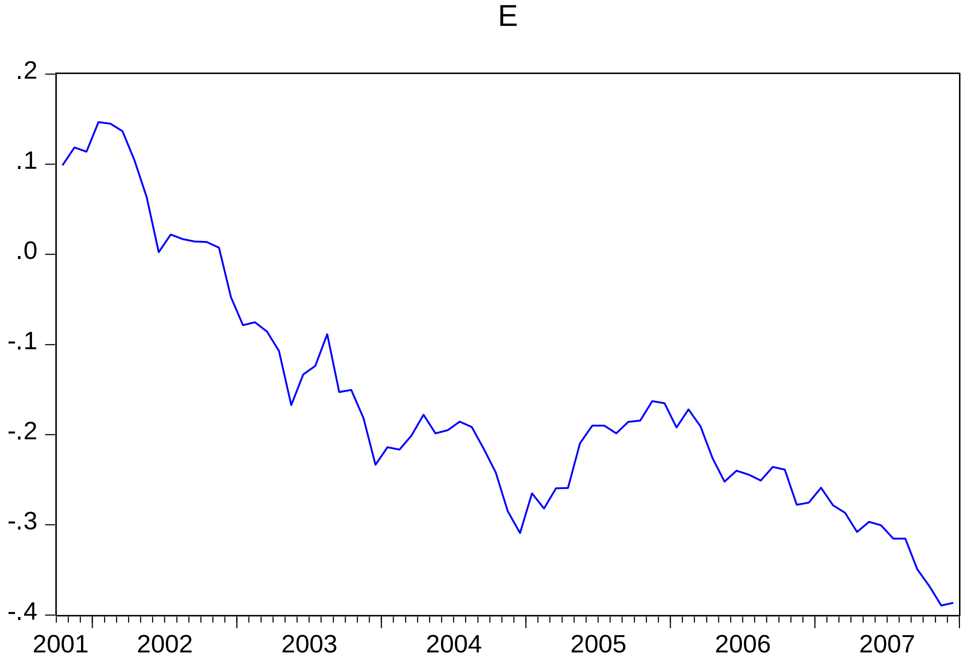
A lot of factors have considerable impact for instance the composition of the export flows. Crucial products or commodities like oil are so important for economies that a depreciation of a currency against oil exporting nations will unlikely have a strong impact for demand for oil and therefore the volume of exports. Other reasons are the continuing internationalisation of production processes so that the costs of products is build up by several currencies and the observed phenomenon that exporters are unlikely to pass through exchange rate swings immediately due to menu costs and in the case exporters do pass through exchange rate swings literature and the empiric study performed in this thesis indicate that pass through is partial most of the time.

Regarding ERPT it can be concluded that the obtained results seem to support earlier research regarding ERPT in the majority of cases although some results were troublesome in its interpretation and some arguably assumptions were made.

Obviously research regarding these important topics has to be continued since each specific situation, again as explained above, will have its own characteristics. A positive development is that newer models continue to incorporate more realistic assumptions and that economic theory had moved from static to dynamic models. Considering that the Eurozone has a short history of existence the author suggests that more research regarding the value of the euro and its impact on the terms of trade of this monetary union has to be done. Longer time series, which clearly contain more observations, will have more statistical value; which is one of the short comings of the study performed in the previous section.

## **Appendix.**

*Stationarity/unit root tests*




Null Hypothesis: E01 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -1.797340 | 0.6962 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(E01)
Method: Least Squares
Date: 05/10/11 Time: 13:52
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| E01(-1) | -0.080321 | 0.044689 | -1.797340 | 0.0765 |
| C | -0.005020 | 0.006032 | -0.832270 | 0.4080 |
| @TREND(2001M10) | -0.000390 | 0.000278 | -1.402901 | 0.1650 |

| | | | |
|---|---|---|---|
| R-squared | 0.045282 | Mean dependent var | -0.006561 |
| Adjusted R-squared | 0.018389 | S.D. dependent var | 0.024624 |
| S.E. of regression | 0.024397 | Akaike info criterion | -4.549036 |
| Sum squared resid | 0.042259 | Schwarz criterion | -4.455628 |
| Log likelihood | 171.3143 | Hannan-Quinn criter. | -4.511775 |
| F-statistic | 1.683762 | Durbin-Watson stat | 1.840655 |
| Prob(F-statistic) | 0.193003 | | |

Null Hypothesis: E01 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -1.797340 | 0.6962 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 0.000571 |
| HAC corrected variance (Bartlett kernel) | 0.000571 |

Phillips-Perron Test Equation
Dependent Variable: D(E01)
Method: Least Squares
Date: 05/10/11 Time: 13:54
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| E01(-1) | -0.080321 | 0.044689 | -1.797340 | 0.0765 |
| C | -0.005020 | 0.006032 | -0.832270 | 0.4080 |
| @TREND(2001M10) | -0.000390 | 0.000278 | -1.402901 | 0.1650 |

| | | | |
|---|---|---|---|
| R-squared | 0.045282 | Mean dependent var | -0.006561 |
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| S.E. of regression | 0.024397 | Akaike info criterion | -4.549036 |
| Sum squared resid | 0.042259 | Schwarz criterion | -4.455628 |
| Log likelihood | 171.3143 | Hannan-Quinn criter. | -4.511775 |
| F-statistic | 1.683762 | Durbin-Watson stat | 1.840655 |
| Prob(F-statistic) | 0.193003 | | |

Null Hypothesis: E01 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.207604 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

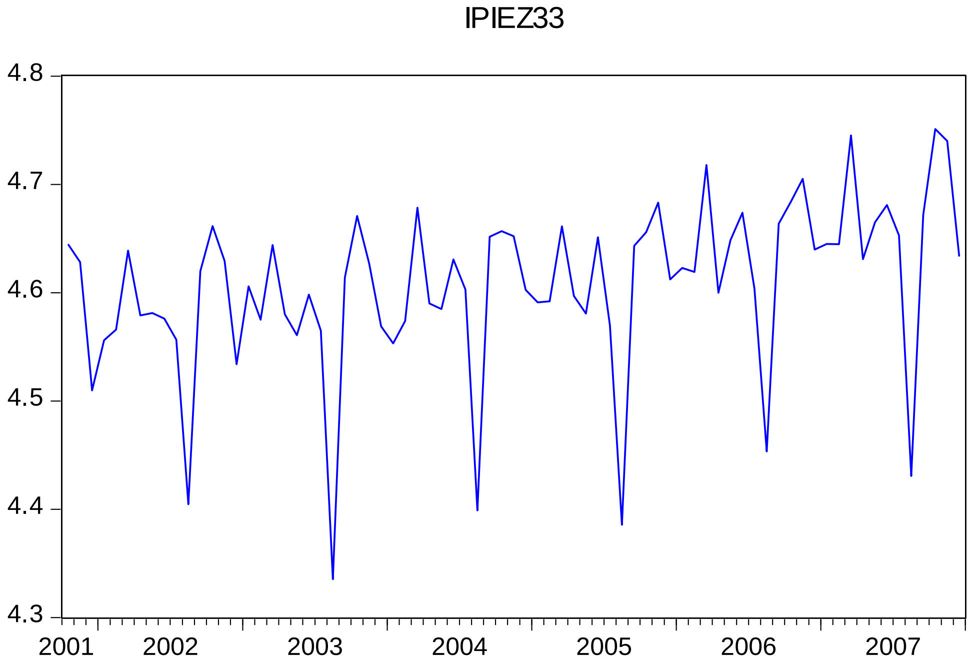
*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

| | |
|---|---|
| Residual variance (no correction) | 0.003978 |
| HAC corrected variance (Bartlett kernel) | 0.022173 |

KPSS Test Equation
Dependent Variable: E01
Method: Least Squares
Date: 05/10/11 Time: 13:55
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.037138 | 0.014618 | 2.540598 | 0.0132 |
| @TREND(2001M10) | -0.005492 | 0.000341 | -16.10563 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.780379 | Mean dependent var | -0.166063 |
| Adjusted R-squared | 0.777371 | S.D. dependent var | 0.135493 |
| S.E. of regression | 0.063930 | Akaike info criterion | -2.635740 |
| Sum squared resid | 0.298358 | Schwarz criterion | -2.573941 |
| Log likelihood | 100.8403 | Hannan-Quinn criter. | -2.611064 |
| F-statistic | 259.3914 | Durbin-Watson stat | 0.148641 |
| Prob(F-statistic) | 0.000000 | | |




Null Hypothesis: IPIEZ33 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -8.293427 | 0.0000 |
| Test critical values: | 1% level | -4.088713 | |
| | 5% level | -3.472558 | |
| | 10% level | -3.163450 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IPIEZ33)
Method: Least Squares
Date: 05/10/11 Time: 13:57
Sample (adjusted): 2001M12 2007M12
Included observations: 73 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ33(-1) | -1.313180 | 0.158340 | -8.293427 | 0.0000 |
| D(IPIEZ33(-1)) | 0.321559 | 0.113276 | 2.838724 | 0.0059 |
| C | 5.979733 | 0.721712 | 8.285488 | 0.0000 |
| @TREND(2001M10) | 0.001817 | 0.000443 | 4.098164 | 0.0001 |

| | | | |
|---|---|---|---|
| R-squared | 0.554626 | Mean dependent var | 6.99E-05 |
| Adjusted R-squared | 0.535262 | S.D. dependent var | 0.103765 |
| S.E. of regression | 0.070738 | Akaike info criterion | -2.406423 |
| Sum squared resid | 0.345270 | Schwarz criterion | -2.280918 |
| Log likelihood | 91.83443 | Hannan-Quinn criter. | -2.356407 |
| F-statistic | 28.64198 | Durbin-Watson stat | 2.114562 |
| Prob(F-statistic) | 0.000000 | | |

Null Hypothesis: IPIEZ33 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 73 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -17.45130 | 0.0001 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 0.005281 |
| HAC corrected variance (Bartlett kernel) | 0.000330 |

Phillips-Perron Test Equation
Dependent Variable: D(IPIEZ33)
Method: Least Squares
Date: 05/10/11 Time: 13:57
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ33(-1) | -0.982943 | 0.117605 | -8.358019 | 0.0000 |
| C | 4.477956 | 0.536385 | 8.348395 | 0.0000 |
| @TREND(2001M10) | 0.001341 | 0.000431 | 3.107979 | 0.0027 |

| | | | |
|---|---|---|---|
| R-squared | 0.496050 | Mean dependent var | -0.000155 |
| Adjusted R-squared | 0.481854 | S.D. dependent var | 0.103070 |
| S.E. of regression | 0.074192 | Akaike info criterion | -2.324621 |
| Sum squared resid | 0.390818 | Schwarz criterion | -2.231213 |
| Log likelihood | 89.01097 | Hannan-Quinn criter. | -2.287359 |
| F-statistic | 34.94345 | Durbin-Watson stat | 2.006791 |
| Prob(F-statistic) | 0.000000 | | |

Null Hypothesis: IPIEZ33 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 53 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.295737 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

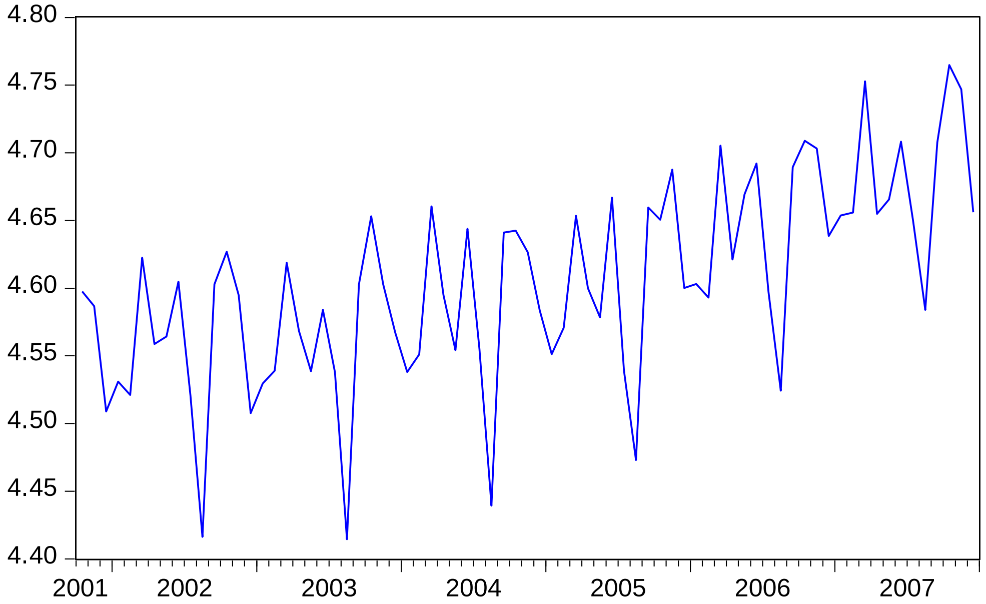
| | |
|---|---|
| Residual variance (no correction) | 0.005313 |
| HAC corrected variance (Bartlett kernel) | 0.000772 |

KPSS Test Equation
Dependent Variable: IPIEZ33
Method: Least Squares
Date: 05/10/11 Time: 13:57
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.560367 | 0.016893 | 269.9628 | 0.0000 |
| @TREND(2001M10) | 0.001269 | 0.000394 | 3.220870 | 0.0019 |

| | | | |
|---|---|---|---|
| R-squared | 0.124427 | Mean dependent var | 4.607328 |
| Adjusted R-squared | 0.112433 | S.D. dependent var | 0.078420 |
| S.E. of regression | 0.073880 | Akaike info criterion | -2.346452 |
| Sum squared resid | 0.398450 | Schwarz criterion | -2.284652 |
| Log likelihood | 89.99195 | Hannan-Quinn criter. | -2.321776 |
| F-statistic | 10.37401 | Durbin-Watson stat | 1.946692 |
| Prob(F-statistic) | 0.001910 | | |

IPIEZ54




Null Hypothesis: IPIEZ54 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -9.129104 | 0.0000 |
| Test critical values: | 1% level | -4.088713 | |
| | 5% level | -3.472558 | |
| | 10% level | -3.163450 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IPIEZ54)
Method: Least Squares
Date: 05/10/11 Time: 13:59
Sample (adjusted): 2001M12 2007M12
Included observations: 73 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ54(-1) | -1.342649 | 0.147073 | -9.129104 | 0.0000 |
| D(IPIEZ54(-1)) | 0.426161 | 0.108191 | 3.938979 | 0.0002 |
| C | 6.072386 | 0.665452 | 9.125203 | 0.0000 |
| @TREND(2001M10) | 0.002866 | 0.000425 | 6.746817 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.573685 | Mean dependent var | 0.000950 |
| Adjusted R-squared | 0.555150 | S.D. dependent var | 0.079600 |
| S.E. of regression | 0.053091 | Akaike info criterion | -2.980381 |
| Sum squared resid | 0.194487 | Schwarz criterion | -2.854877 |
| Log likelihood | 112.7839 | Hannan-Quinn criter. | -2.930366 |
| F-statistic | 30.95072 | Durbin-Watson stat | 2.094518 |
| Prob(F-statistic) | 0.000000 | | |

Null Hypothesis: IPIEZ54 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 73 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -11.36681 | 0.0000 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 0.003263 |
| HAC corrected variance (Bartlett kernel) | 0.000468 |

Phillips-Perron Test Equation
Dependent Variable: D(IPIEZ54)
Method: Least Squares
Date: 05/10/11 Time: 13:59
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ54(-1) | -0.932411 | 0.117338 | -7.946353 | 0.0000 |
| C | 4.218839 | 0.531228 | 7.941676 | 0.0000 |
| @TREND(2001M10) | 0.001986 | 0.000400 | 4.962948 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.470817 | Mean dependent var | 0.000789 |
| Adjusted R-squared | 0.455911 | S.D. dependent var | 0.079065 |
| S.E. of regression | 0.058320 | Akaike info criterion | -2.806032 |
| Sum squared resid | 0.241490 | Schwarz criterion | -2.712624 |
| Log likelihood | 106.8232 | Hannan-Quinn criter. | -2.768770 |
| F-statistic | 31.58461 | Durbin-Watson stat | 1.959129 |
| Prob(F-statistic) | 0.000000 | | |

Null Hypothesis: IPIEZ54 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 74 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.500000 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

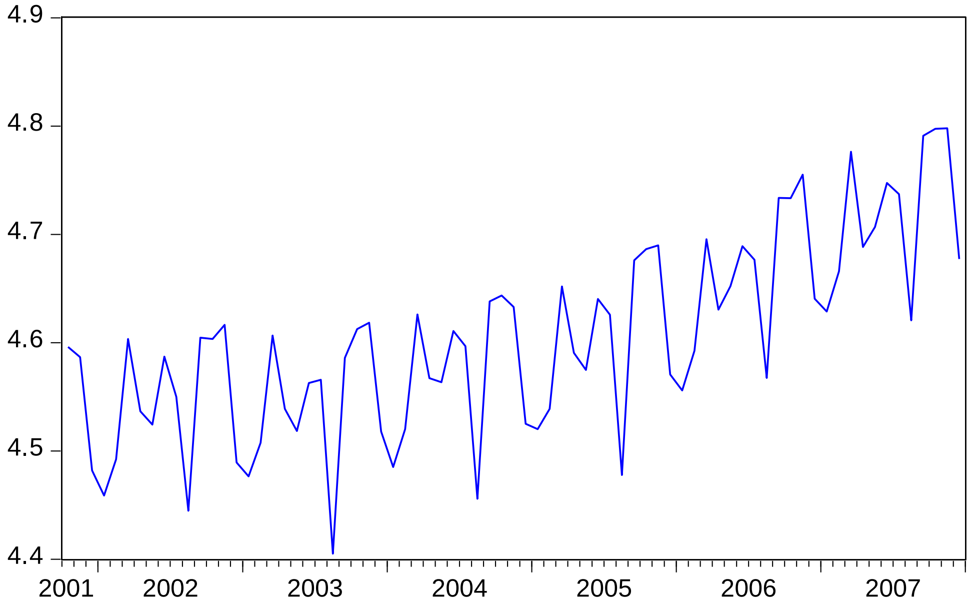
| | |
|---|---|
| Residual variance (no correction) | 0.003302 |
| HAC corrected variance (Bartlett kernel) | 0.000664 |

KPSS Test Equation
Dependent Variable: IPIEZ54
Method: Least Squares
Date: 05/10/11 Time: 13:59
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.528543 | 0.013318 | 340.0374 | 0.0000 |
| @TREND(2001M10) | 0.002049 | 0.000311 | 6.596544 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.373468 | Mean dependent var | 4.604369 |
| Adjusted R-squared | 0.364885 | S.D. dependent var | 0.073086 |
| S.E. of regression | 0.058245 | Akaike info criterion | -2.822001 |
| Sum squared resid | 0.247654 | Schwarz criterion | -2.760201 |
| Log likelihood | 107.8250 | Hannan-Quinn criter. | -2.797325 |
| F-statistic | 43.51440 | Durbin-Watson stat | 1.843152 |
| Prob(F-statistic) | 0.000000 | | |

IPIEZ78




Null Hypothesis: IPIEZ78 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -7.905823 | 0.0000 |
| Test critical values: | 1% level | -4.088713 | |
| | 5% level | -3.472558 | |
| | 10% level | -3.163450 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IPIEZ78)
Method: Least Squares
Date: 05/10/11 Time: 14:01
Sample (adjusted): 2001M12 2007M12
Included observations: 73 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ78(-1) | -1.190883 | 0.150634 | -7.905823 | 0.0000 |
| D(IPIEZ78(-1)) | 0.297534 | 0.113161 | 2.629289 | 0.0105 |
| C | 5.343921 | 0.676438 | 7.900084 | 0.0000 |
| @TREND(2001M10) | 0.003661 | 0.000557 | 6.577841 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.519479 | Mean dependent var | 0.001239 |
| Adjusted R-squared | 0.498587 | S.D. dependent var | 0.084073 |
| S.E. of regression | 0.059533 | Akaike info criterion | -2.751339 |
| Sum squared resid | 0.244547 | Schwarz criterion | -2.625835 |
| Log likelihood | 104.4239 | Hannan-Quinn criter. | -2.701324 |
| F-statistic | 24.86469 | Durbin-Watson stat | 2.090526 |
| Prob(F-statistic) | 0.000000 | | |

Null Hypothesis: IPIEZ78 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 38 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -7.698220 | 0.0000 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 0.003736 |
| HAC corrected variance (Bartlett kernel) | 0.003326 |

Phillips-Perron Test Equation
Dependent Variable: D(IPIEZ78)
Method: Least Squares
Date: 05/10/11 Time: 14:02
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ78(-1) | -0.897458 | 0.116167 | -7.725561 | 0.0000 |
| C | 4.030448 | 0.522109 | 7.719552 | 0.0000 |
| @TREND(2001M10) | 0.002728 | 0.000483 | 5.643888 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.456885 | Mean dependent var | 0.001098 |
| Adjusted R-squared | 0.441586 | S.D. dependent var | 0.083504 |
| S.E. of regression | 0.062400 | Akaike info criterion | -2.670794 |
| Sum squared resid | 0.276461 | Schwarz criterion | -2.577386 |
| Log likelihood | 101.8194 | Hannan-Quinn criter. | -2.633532 |
| F-statistic | 29.86374 | Durbin-Watson stat | 1.967762 |
| Prob(F-statistic) | 0.000000 | | |

Null Hypothesis: IPIEZ78 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 17 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.157645 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

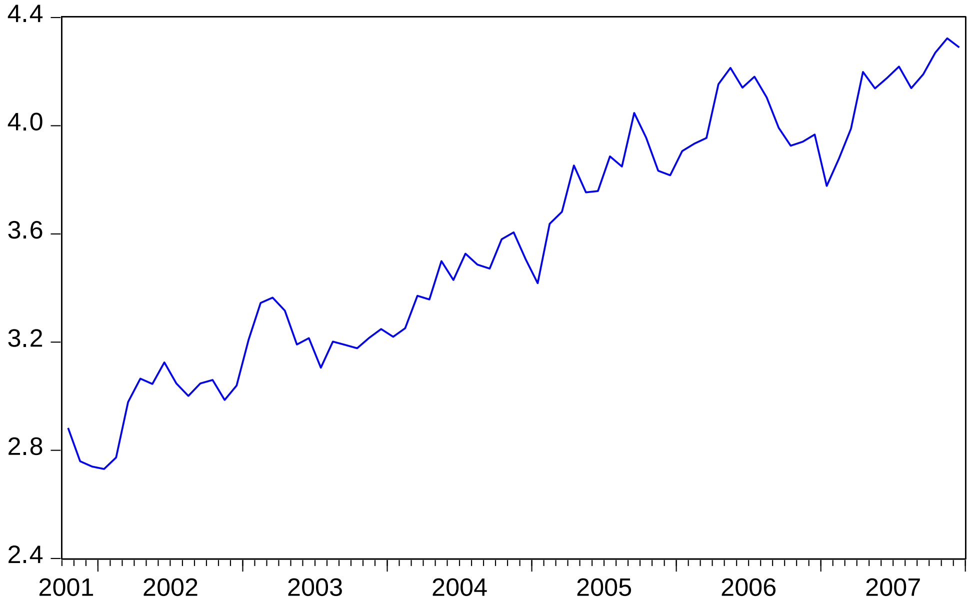
| | |
|---|---|
| Residual variance (no correction) | 0.003865 |
| HAC corrected variance (Bartlett kernel) | 0.005626 |

KPSS Test Equation
Dependent Variable: IPIEZ78
Method: Least Squares
Date: 05/10/11 Time: 14:02
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.496610 | 0.014409 | 312.0784 | 0.0000 |
| @TREND(2001M10) | 0.002922 | 0.000336 | 8.692469 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.508613 | Mean dependent var | 4.604711 |
| Adjusted R-squared | 0.501881 | S.D. dependent var | 0.089286 |
| S.E. of regression | 0.063016 | Akaike info criterion | -2.664552 |
| Sum squared resid | 0.289884 | Schwarz criterion | -2.602752 |
| Log likelihood | 101.9207 | Hannan-Quinn criter. | -2.639876 |
| F-statistic | 75.55902 | Durbin-Watson stat | 1.756820 |
| Prob(F-statistic) | 0.000000 | | |

PM33



Null Hypothesis: PM33 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.525699 | 0.0439 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PM33)
Method: Least Squares
Date: 05/10/11 Time: 14:04
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PM33(-1) | -0.296597 | 0.084124 | -3.525699 | 0.0007 |
| C | 0.848218 | 0.236408 | 3.587937 | 0.0006 |
| @TREND(2001M10) | 0.006056 | 0.001772 | 3.418266 | 0.0010 |

| | | | |
|---|---|---|---|
| R-squared | 0.149043 | Mean dependent var | 0.019018 |
| Adjusted R-squared | 0.125073 | S.D. dependent var | 0.092226 |
| S.E. of regression | 0.086266 | Akaike info criterion | -2.023078 |
| Sum squared resid | 0.528363 | Schwarz criterion | -1.929670 |
| Log likelihood | 77.85388 | Hannan-Quinn criter. | -1.985816 |
| F-statistic | 6.217748 | Durbin-Watson stat | 1.776535 |
| Prob(F-statistic) | 0.003249 | | |

Null Hypothesis: PM33 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -3.525699 | 0.0439 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 0.007140 |
| HAC corrected variance (Bartlett kernel) | 0.007140 |

Phillips-Perron Test Equation
Dependent Variable: D(PM33)
Method: Least Squares
Date: 05/10/11 Time: 14:04
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PM33(-1) | -0.296597 | 0.084124 | -3.525699 | 0.0007 |
| C | 0.848218 | 0.236408 | 3.587937 | 0.0006 |
| @TREND(2001M10) | 0.006056 | 0.001772 | 3.418266 | 0.0010 |

| | | | |
|---|---|---|---|
| R-squared | 0.149043 | Mean dependent var | 0.019018 |
| Adjusted R-squared | 0.125073 | S.D. dependent var | 0.092226 |
| S.E. of regression | 0.086266 | Akaike info criterion | -2.023078 |
| Sum squared resid | 0.528363 | Schwarz criterion | -1.929670 |
| Log likelihood | 77.85388 | Hannan-Quinn criter. | -1.985816 |
| F-statistic | 6.217748 | Durbin-Watson stat | 1.776535 |
| Prob(F-statistic) | 0.003249 | | |

Null Hypothesis: PM33 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.085851 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

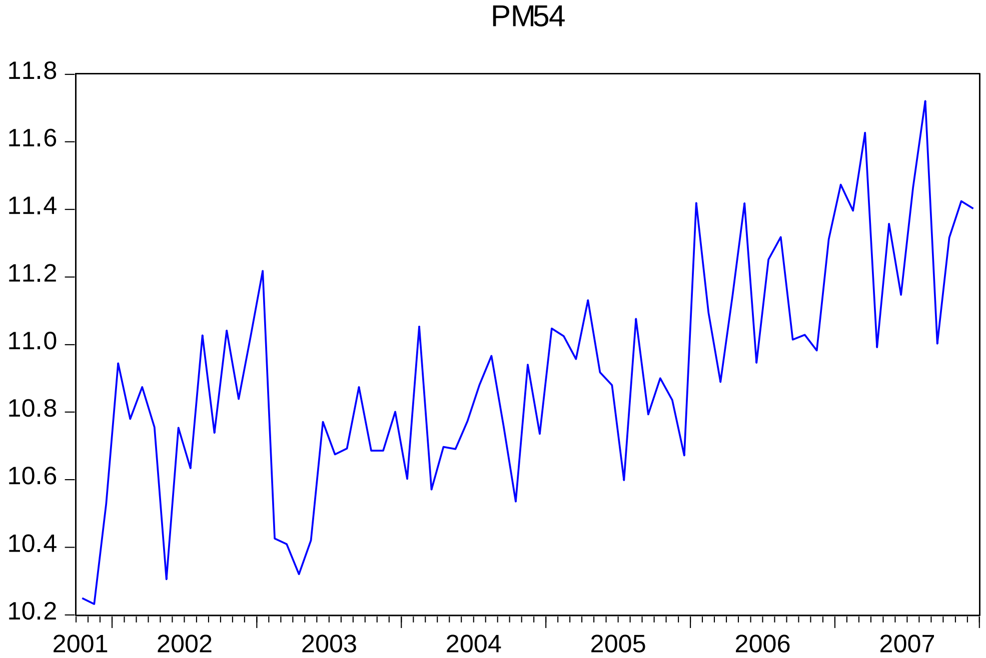
*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

| | |
|---|---|
| Residual variance (no correction) | 0.014035 |
| HAC corrected variance (Bartlett kernel) | 0.041942 |

KPSS Test Equation
Dependent Variable: PM33
Method: Least Squares
Date: 05/10/11 Time: 14:04
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 2.821041 | 0.027456 | 102.7469 | 0.0000 |
| @TREND(2001M10) | 0.020271 | 0.000640 | 31.64906 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.932072 | Mean dependent var | 3.571056 |
| Adjusted R-squared | 0.931141 | S.D. dependent var | 0.457605 |
| S.E. of regression | 0.120080 | Akaike info criterion | -1.375015 |
| Sum squared resid | 1.052599 | Schwarz criterion | -1.313216 |
| Log likelihood | 53.56307 | Hannan-Quinn criter. | -1.350339 |
| F-statistic | 1001.663 | Durbin-Watson stat | 0.589988 |
| Prob(F-statistic) | 0.000000 | | |




Null Hypothesis: PM54 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -7.127426 | 0.0000 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PM54)
Method: Least Squares
Date: 05/10/11 Time: 14:06
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PM54(-1) | -0.824948 | 0.115743 | -7.127426 | 0.0000 |
| C | 8.695306 | 1.217874 | 7.139741 | 0.0000 |
| @TREND(2001M10) | 0.008587 | 0.001746 | 4.919356 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.417211 | Mean dependent var | 0.015588 |
| Adjusted R-squared | 0.400795 | S.D. dependent var | 0.293141 |
| S.E. of regression | 0.226915 | Akaike info criterion | -0.088785 |
| Sum squared resid | 3.655827 | Schwarz criterion | 0.004623 |
| Log likelihood | 6.285029 | Hannan-Quinn criter. | -0.051523 |
| F-statistic | 25.41402 | Durbin-Watson stat | 2.053501 |
| Prob(F-statistic) | 0.000000 | | |

Null Hypothesis: PM54 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -7.136922 | 0.0000 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 0.049403 |
| HAC corrected variance (Bartlett kernel) | 0.050137 |

Phillips-Perron Test Equation
Dependent Variable: D(PM54)
Method: Least Squares
Date: 05/10/11 Time: 14:06
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PM54(-1) | -0.824948 | 0.115743 | -7.127426 | 0.0000 |
| C | 8.695306 | 1.217874 | 7.139741 | 0.0000 |
| @TREND(2001M10) | 0.008587 | 0.001746 | 4.919356 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.417211 | Mean dependent var | 0.015588 |
| Adjusted R-squared | 0.400795 | S.D. dependent var | 0.293141 |
| S.E. of regression | 0.226915 | Akaike info criterion | -0.088785 |
| Sum squared resid | 3.655827 | Schwarz criterion | 0.004623 |
| Log likelihood | 6.285029 | Hannan-Quinn criter. | -0.051523 |
| F-statistic | 25.41402 | Durbin-Watson stat | 2.053501 |
| Prob(F-statistic) | 0.000000 | | |

Null Hypothesis: PM54 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.149795 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

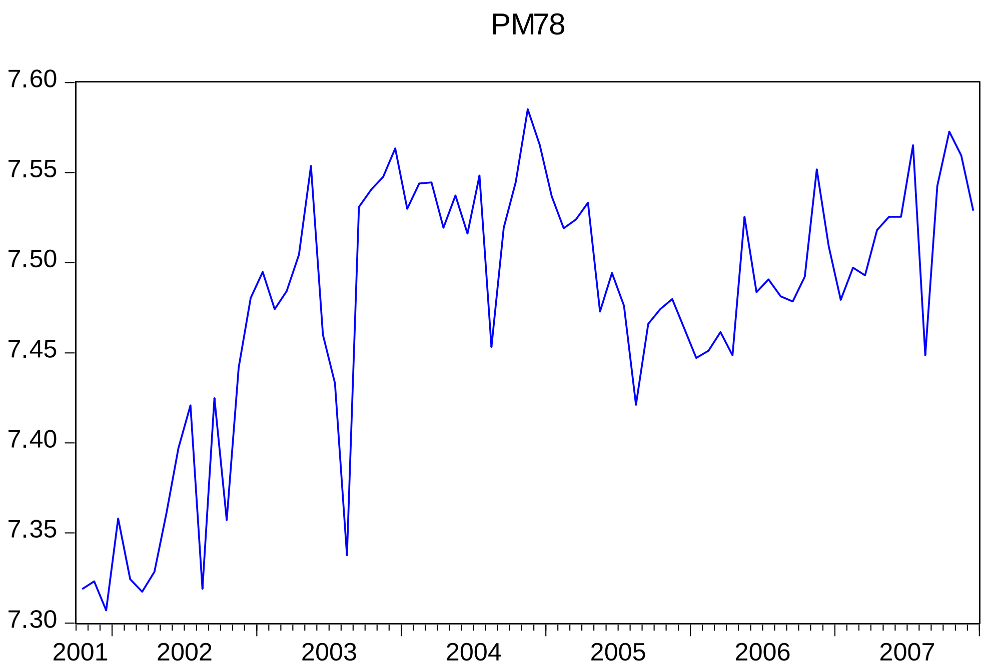
*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

| | |
|---|---|
| Residual variance (no correction) | 0.051352 |
| HAC corrected variance (Bartlett kernel) | 0.071125 |

KPSS Test Equation
Dependent Variable: PM54
Method: Least Squares
Date: 05/10/11   Time: 14:06
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 10.52050 | 0.052519 | 200.3163 | 0.0000 |
| @TREND(2001M10) | 0.010755 | 0.001225 | 8.778478 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.513533 | Mean dependent var | 10.91843 |
| Adjusted R-squared | 0.506869 | S.D. dependent var | 0.327091 |
| S.E. of regression | 0.229694 | Akaike info criterion | -0.077833 |
| Sum squared resid | 3.851429 | Schwarz criterion | -0.016034 |
| Log likelihood | 4.918753 | Hannan-Quinn criter. | -0.053157 |
| F-statistic | 77.06167 | Durbin-Watson stat | 1.629192 |
| Prob(F-statistic) | 0.000000 | | |




Null Hypothesis: PM78 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.872572 | 0.1774 |
| Test critical values: | 1% level | -4.088713 | |
| | 5% level | -3.472558 | |
| | 10% level | -3.163450 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PM78)
Method: Least Squares
Date: 05/10/11 Time: 14:07
Sample (adjusted): 2001M12 2007M12
Included observations: 73 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PM78(-1) | -0.269883 | 0.093952 | -2.872572 | 0.0054 |
| D(PM78(-1)) | -0.271659 | 0.113796 | -2.387243 | 0.0197 |
| C | 2.008371 | 0.695754 | 2.886611 | 0.0052 |
| @TREND(2001M10) | 0.000356 | 0.000300 | 1.188463 | 0.2387 |

| | | | |
|---|---|---|---|
| R-squared | 0.251478 | Mean dependent var | 0.002818 |
| Adjusted R-squared | 0.218934 | S.D. dependent var | 0.049188 |
| S.E. of regression | 0.043471 | Akaike info criterion | -3.380207 |
| Sum squared resid | 0.130392 | Schwarz criterion | -3.254702 |
| Log likelihood | 127.3775 | Hannan-Quinn criter. | -3.330191 |
| F-statistic | 7.727231 | Durbin-Watson stat | 2.004819 |
| Prob(F-statistic) | 0.000160 | | |

Null Hypothesis: PM78 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -3.776825 | 0.0233 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 0.001923 |
| HAC corrected variance (Bartlett kernel) | 0.001633 |

Phillips-Perron Test Equation
Dependent Variable: D(PM78)
Method: Least Squares
Date: 05/10/11 Time: 14:07
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PM78(-1) | -0.346710 | 0.087576 | -3.958967 | 0.0002 |
| C | 2.573859 | 0.648392 | 3.969604 | 0.0002 |
| @TREND(2001M10) | 0.000559 | 0.000298 | 1.878147 | 0.0645 |

| | | | |
|---|---|---|---|
| R-squared | 0.183015 | Mean dependent var | 0.002838 |
| Adjusted R-squared | 0.160002 | S.D. dependent var | 0.048850 |
| S.E. of regression | 0.044772 | Akaike info criterion | -3.334788 |
| Sum squared resid | 0.142319 | Schwarz criterion | -3.241380 |
| Log likelihood | 126.3872 | Hannan-Quinn criter. | -3.297526 |
| F-statistic | 7.952472 | Durbin-Watson stat | 2.375727 |
| Prob(F-statistic) | 0.000765 | | |

Null Hypothesis: PM78 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.205474 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

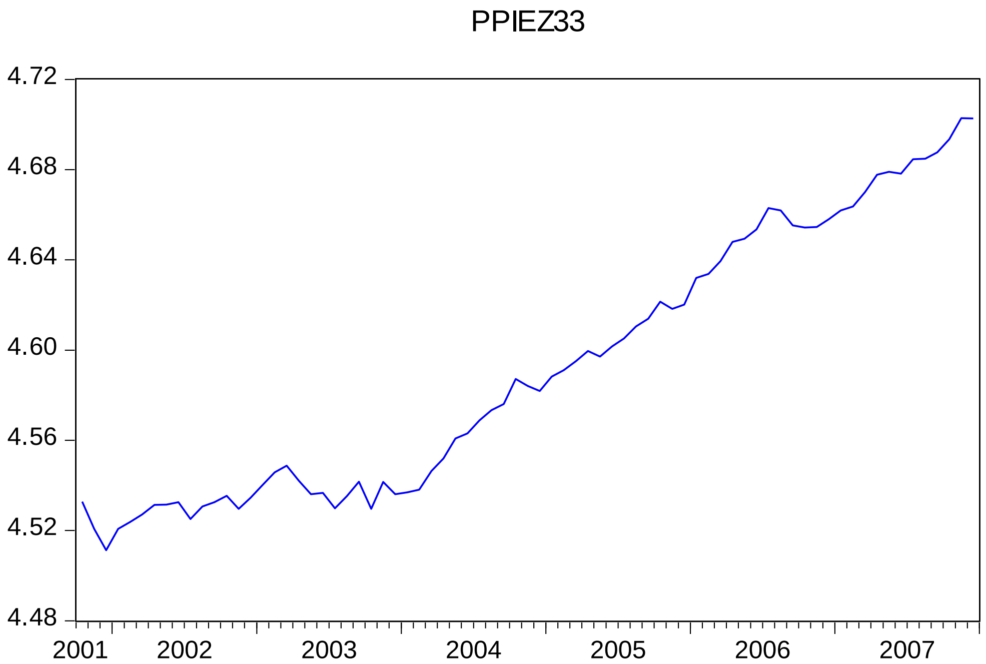
*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

| | |
|---|---|
| Residual variance (no correction) | 0.003490 |
| HAC corrected variance (Bartlett kernel) | 0.014572 |

KPSS Test Equation
Dependent Variable: PM78
Method: Least Squares
Date: 05/10/11 Time: 14:07
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 7.405277 | 0.013691 | 540.8693 | 0.0000 |
| @TREND(2001M10) | 0.001929 | 0.000319 | 6.038866 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.333138 | Mean dependent var | 7.476640 |
| Adjusted R-squared | 0.324003 | S.D. dependent var | 0.072829 |
| S.E. of regression | 0.059880 | Akaike info criterion | -2.766660 |
| Sum squared resid | 0.261746 | Schwarz criterion | -2.704860 |
| Log likelihood | 105.7497 | Hannan-Quinn criter. | -2.741984 |
| F-statistic | 36.46790 | Durbin-Watson stat | 0.665769 |
| Prob(F-statistic) | 0.000000 | | |




Null Hypothesis: PPIEZ33 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.745634 | 0.2221 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PPIEZ33)
Method: Least Squares
Date: 05/10/11 Time: 14:09
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PPIEZ33(-1) | -0.115720 | 0.042147 | -2.745634 | 0.0076 |
| C | 0.520096 | 0.189372 | 2.746418 | 0.0076 |
| @TREND(2001M10) | 0.000358 | 0.000113 | 3.171003 | 0.0022 |

| | | | |
|---|---|---|---|
| R-squared | 0.144470 | Mean dependent var | 0.002296 |
| Adjusted R-squared | 0.120371 | S.D. dependent var | 0.005294 |
| S.E. of regression | 0.004965 | Akaike info criterion | -7.732941 |
| Sum squared resid | 0.001751 | Schwarz criterion | -7.639533 |
| Log likelihood | 289.1188 | Hannan-Quinn criter. | -7.695680 |
| F-statistic | 5.994764 | Durbin-Watson stat | 2.040409 |
| Prob(F-statistic) | 0.003930 | | |

Null Hypothesis: PPIEZ33 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -2.738476 | 0.2248 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 2.37E-05 |
| HAC corrected variance (Bartlett kernel) | 2.24E-05 |

Phillips-Perron Test Equation
Dependent Variable: D(PPIEZ33)
Method: Least Squares
Date: 05/10/11 Time: 14:09
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PPIEZ33(-1) | -0.115720 | 0.042147 | -2.745634 | 0.0076 |
| C | 0.520096 | 0.189372 | 2.746418 | 0.0076 |
| @TREND(2001M10) | 0.000358 | 0.000113 | 3.171003 | 0.0022 |

| | | | |
|---|---|---|---|
| R-squared | 0.144470 | Mean dependent var | 0.002296 |
| Adjusted R-squared | 0.120371 | S.D. dependent var | 0.005294 |
| S.E. of regression | 0.004965 | Akaike info criterion | -7.732941 |
| Sum squared resid | 0.001751 | Schwarz criterion | -7.639533 |
| Log likelihood | 289.1188 | Hannan-Quinn criter. | -7.695680 |
| F-statistic | 5.994764 | Durbin-Watson stat | 2.040409 |
| Prob(F-statistic) | 0.003930 | | |

Null Hypothesis: PPIEZ33 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.244010 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

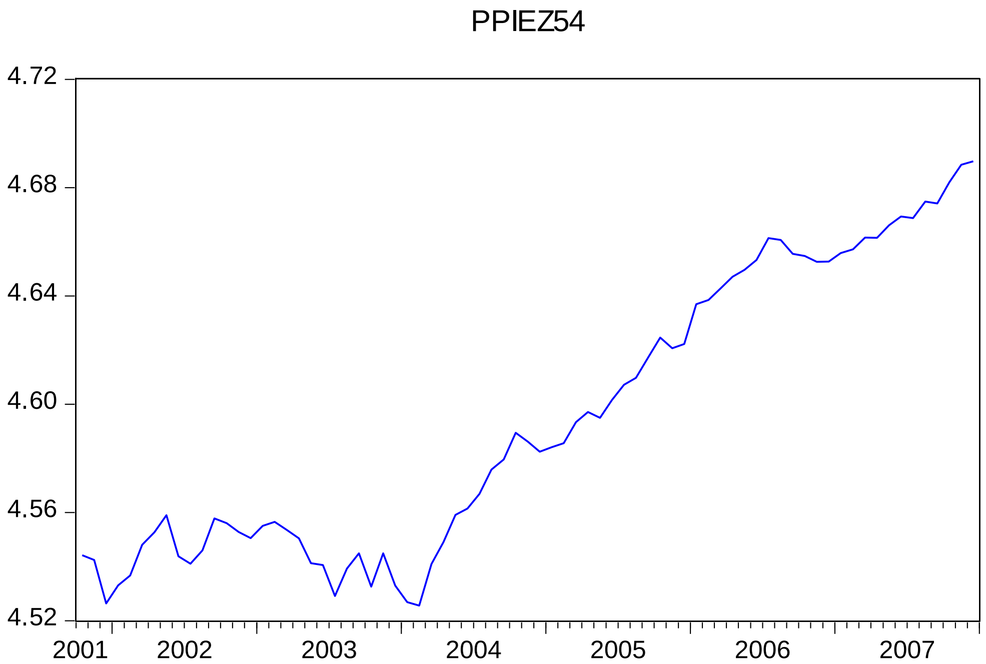
*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

| | |
|---|---|
| Residual variance (no correction) | 0.000188 |
| HAC corrected variance (Bartlett kernel) | 0.001037 |

KPSS Test Equation
Dependent Variable: PPIEZ33
Method: Least Squares
Date: 05/10/11 Time: 14:10
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.495305 | 0.003176 | 1415.462 | 0.0000 |
| @TREND(2001M10) | 0.002615 | 7.41E-05 | 35.29326 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.944639 | Mean dependent var | 4.592048 |
| Adjusted R-squared | 0.943880 | S.D. dependent var | 0.058632 |
| S.E. of regression | 0.013890 | Akaike info criterion | -5.689046 |
| Sum squared resid | 0.014083 | Schwarz criterion | -5.627246 |
| Log likelihood | 215.3392 | Hannan-Quinn criter. | -5.664370 |
| F-statistic | 1245.614 | Durbin-Watson stat | 0.145821 |
| Prob(F-statistic) | 0.000000 | | |




Null Hypothesis: PPIEZ54 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.041251 | 0.5692 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PPIEZ54)
Method: Least Squares
Date: 05/10/11 Time: 14:11
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PPIEZ54(-1) | -0.083551 | 0.040931 | -2.041251 | 0.0449 |
| C | 0.376847 | 0.184585 | 2.041587 | 0.0449 |
| @TREND(2001M10) | 0.000236 | 9.73E-05 | 2.430567 | 0.0176 |

| | | | |
|---|---|---|---|
| R-squared | 0.082166 | Mean dependent var | 0.001967 |
| Adjusted R-squared | 0.056311 | S.D. dependent var | 0.006453 |
| S.E. of regression | 0.006269 | Akaike info criterion | -7.266689 |
| Sum squared resid | 0.002790 | Schwarz criterion | -7.173281 |
| Log likelihood | 271.8675 | Hannan-Quinn criter. | -7.229427 |
| F-statistic | 3.178013 | Durbin-Watson stat | 1.947480 |
| Prob(F-statistic) | 0.047657 | | |

Null Hypothesis: PPIEZ54 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -2.064017 | 0.5568 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 3.77E-05 |
| HAC corrected variance (Bartlett kernel) | 3.96E-05 |

Phillips-Perron Test Equation
Dependent Variable: D(PPIEZ54)
Method: Least Squares
Date: 05/10/11 Time: 14:11
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PPIEZ54(-1) | -0.083551 | 0.040931 | -2.041251 | 0.0449 |
| C | 0.376847 | 0.184585 | 2.041587 | 0.0449 |
| @TREND(2001M10) | 0.000236 | 9.73E-05 | 2.430567 | 0.0176 |

| | | | |
|---|---|---|---|
| R-squared | 0.082166 | Mean dependent var | 0.001967 |
| Adjusted R-squared | 0.056311 | S.D. dependent var | 0.006453 |
| S.E. of regression | 0.006269 | Akaike info criterion | -7.266689 |
| Sum squared resid | 0.002790 | Schwarz criterion | -7.173281 |
| Log likelihood | 271.8675 | Hannan-Quinn criter. | -7.229427 |
| F-statistic | 3.178013 | Durbin-Watson stat | 1.947480 |
| Prob(F-statistic) | 0.047657 | | |

Null Hypothesis: PPIEZ54 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.216121 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

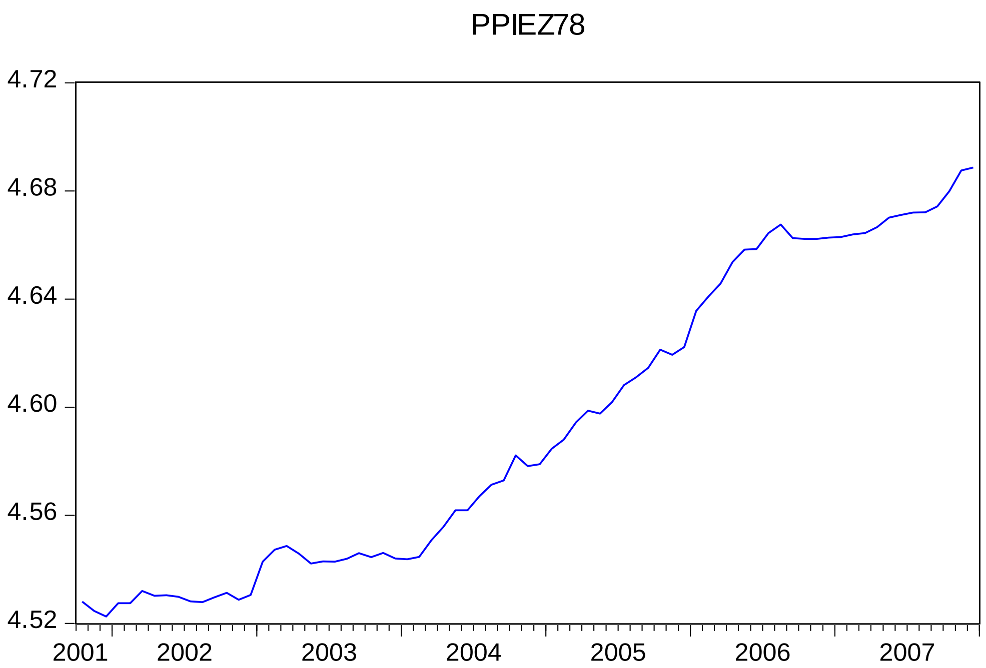
*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

| | |
|---|---|
| Residual variance (no correction) | 0.000315 |
| HAC corrected variance (Bartlett kernel) | 0.001810 |

KPSS Test Equation
Dependent Variable: PPIEZ54
Method: Least Squares
Date: 05/10/11 Time: 14:12
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.511367 | 0.004114 | 1096.718 | 0.0000 |
| @TREND(2001M10) | 0.002239 | 9.60E-05 | 23.33704 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.881804 | Mean dependent var | 4.594223 |
| Adjusted R-squared | 0.880185 | S.D. dependent var | 0.051974 |
| S.E. of regression | 0.017990 | Akaike info criterion | -5.171645 |
| Sum squared resid | 0.023627 | Schwarz criterion | -5.109846 |
| Log likelihood | 195.9367 | Hannan-Quinn criter. | -5.146969 |
| F-statistic | 544.6176 | Durbin-Watson stat | 0.128906 |
| Prob(F-statistic) | 0.000000 | | |



Null Hypothesis: PPIEZ78 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.017485 | 0.5820 |
| Test critical values: | 1% level | -4.088713 | |
| | 5% level | -3.472558 | |
| | 10% level | -3.163450 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PPIEZ78)
Method: Least Squares
Date: 05/10/11 Time: 14:12
Sample (adjusted): 2001M12 2007M12
Included observations: 73 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PPIEZ78(-1) | -0.064159 | 0.031802 | -2.017485 | 0.0475 |
| D(PPIEZ78(-1)) | 0.181899 | 0.114201 | 1.592798 | 0.1158 |
| C | 0.289430 | 0.142983 | 2.024229 | 0.0468 |
| @TREND(2001M10) | 0.000185 | 8.27E-05 | 2.243928 | 0.0280 |

| | | | |
|---|---|---|---|
| R-squared | 0.115902 | Mean dependent var | 0.002247 |
| Adjusted R-squared | 0.077463 | S.D. dependent var | 0.003545 |
| S.E. of regression | 0.003405 | Akaike info criterion | -8.473778 |
| Sum squared resid | 0.000800 | Schwarz criterion | -8.348273 |
| Log likelihood | 313.2929 | Hannan-Quinn criter. | -8.423762 |
| F-statistic | 3.015205 | Durbin-Watson stat | 1.976377 |
| Prob(F-statistic) | 0.035743 | | |

Null Hypothesis: PPIEZ78 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -2.268561 | 0.4453 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 1.13E-05 |
| HAC corrected variance (Bartlett kernel) | 1.51E-05 |

Phillips-Perron Test Equation
Dependent Variable: D(PPIEZ78)
Method: Least Squares
Date: 05/10/11 Time: 14:13
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PPIEZ78(-1) | -0.069494 | 0.030952 | -2.245247 | 0.0279 |
| C | 0.313417 | 0.139212 | 2.251365 | 0.0275 |
| @TREND(2001M10) | 0.000209 | 7.95E-05 | 2.623075 | 0.0107 |

| | | | |
|---|---|---|---|
| R-squared | 0.107600 | Mean dependent var | 0.002171 |
| Adjusted R-squared | 0.082462 | S.D. dependent var | 0.003582 |
| S.E. of regression | 0.003431 | Akaike info criterion | -8.472113 |
| Sum squared resid | 0.000836 | Schwarz criterion | -8.378705 |
| Log likelihood | 316.4682 | Hannan-Quinn criter. | -8.434852 |
| F-statistic | 4.280373 | Durbin-Watson stat | 1.616382 |
| Prob(F-statistic) | 0.017574 | | |

Null Hypothesis: PPIEZ78 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.213633 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

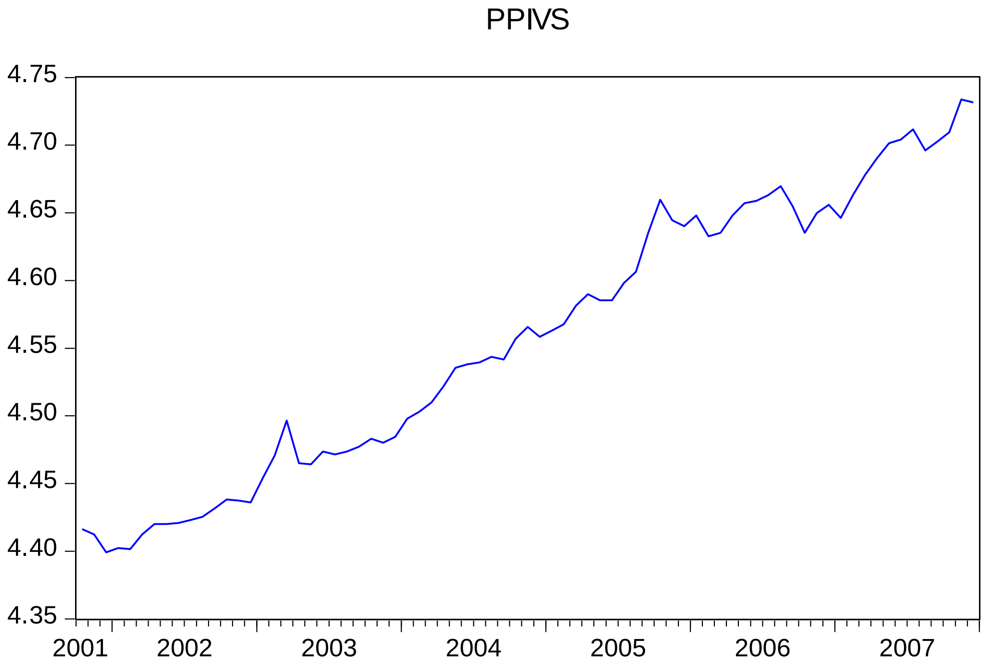
*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

| | |
|---|---|
| Residual variance (no correction) | 0.000164 |
| HAC corrected variance (Bartlett kernel) | 0.000960 |

KPSS Test Equation
Dependent Variable: PPIEZ78
Method: Least Squares
Date: 05/10/11 Time: 14:13
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.500038 | 0.002968 | 1516.034 | 0.0000 |
| @TREND(2001M10) | 0.002501 | 6.92E-05 | 36.11625 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.947001 | Mean dependent var | 4.592567 |
| Adjusted R-squared | 0.946275 | S.D. dependent var | 0.056008 |
| S.E. of regression | 0.012982 | Akaike info criterion | -5.824225 |
| Sum squared resid | 0.012303 | Schwarz criterion | -5.762426 |
| Log likelihood | 220.4084 | Hannan-Quinn criter. | -5.799549 |
| F-statistic | 1304.383 | Durbin-Watson stat | 0.076792 |
| Prob(F-statistic) | 0.000000 | | |




Null Hypothesis: PPIVS has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on AIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.879132 | 0.0179 |
| Test critical values: | 1% level | -4.088713 | |
| | 5% level | -3.472558 | |
| | 10% level | -3.163450 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PPIVS)
Method: Least Squares
Date: 05/10/11 Time: 14:14
Sample (adjusted): 2001M12 2007M12
Included observations: 73 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PPIVS(-1) | -0.324995 | 0.083780 | -3.879132 | 0.0002 |
| D(PPIVS(-1)) | 0.182394 | 0.115399 | 1.580545 | 0.1186 |
| C | 1.426429 | 0.366898 | 3.887811 | 0.0002 |
| @TREND(2001M10) | 0.001534 | 0.000392 | 3.908513 | 0.0002 |

| | | | |
|---|---|---|---|
| R-squared | 0.182704 | Mean dependent var | 0.004372 |
| Adjusted R-squared | 0.147170 | S.D. dependent var | 0.010579 |
| S.E. of regression | 0.009769 | Akaike info criterion | -6.365915 |
| Sum squared resid | 0.006585 | Schwarz criterion | -6.240410 |
| Log likelihood | 236.3559 | Hannan-Quinn criter. | -6.315899 |
| F-statistic | 5.141590 | Durbin-Watson stat | 1.939930 |
| Prob(F-statistic) | 0.002879 | | |

Null Hypothesis: PPIVS has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -3.613043 | 0.0355 |
| Test critical values: | 1% level | -4.086877 | |
| | 5% level | -3.471693 | |
| | 10% level | -3.162948 | |

*MacKinnon (1996) one-sided p-values.

| | |
|---|---|
| Residual variance (no correction) | 9.22E-05 |
| HAC corrected variance (Bartlett kernel) | 9.22E-05 |

Phillips-Perron Test Equation
Dependent Variable: D(PPIVS)
Method: Least Squares
Date: 05/10/11 Time: 14:14
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PPIVS(-1) | -0.278935 | 0.077202 | -3.613043 | 0.0006 |
| C | 1.225232 | 0.338312 | 3.621601 | 0.0005 |
| @TREND(2001M10) | 0.001325 | 0.000361 | 3.672165 | 0.0005 |

| | | | |
|---|---|---|---|
| R-squared | 0.159772 | Mean dependent var | 0.004261 |
| Adjusted R-squared | 0.136104 | S.D. dependent var | 0.010549 |
| S.E. of regression | 0.009805 | Akaike info criterion | -6.372126 |
| Sum squared resid | 0.006826 | Schwarz criterion | -6.278718 |
| Log likelihood | 238.7687 | Hannan-Quinn criter. | -6.334865 |
| F-statistic | 6.750459 | Durbin-Watson stat | 1.725484 |
| Prob(F-statistic) | 0.002071 | | |

Null Hypothesis: PPIVS is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

| | | LM-Stat. |
|---|---|---|
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | 0.104948 |
| Asymptotic critical values*: | 1% level | 0.216000 |
| | 5% level | 0.146000 |
| | 10% level | 0.119000 |

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

| | |
|---|---|
| Residual variance (no correction) | 0.000215 |
| HAC corrected variance (Bartlett kernel) | 0.000695 |

KPSS Test Equation
Dependent Variable: PPIVS
Method: Least Squares
Date: 05/10/11 Time: 14:14
Sample: 2001M10 2007M12
Included observations: 75

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.386621 | 0.003400 | 1290.347 | 0.0000 |
| @TREND(2001M10) | 0.004627 | 7.93E-05 | 58.34477 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.979006 | Mean dependent var | 4.557817 |
| Adjusted R-squared | 0.978718 | S.D. dependent var | 0.101917 |
| S.E. of regression | 0.014868 | Akaike info criterion | -5.552905 |
| Sum squared resid | 0.016137 | Schwarz criterion | -5.491105 |
| Log likelihood | 210.2339 | Hannan-Quinn criter. | -5.528229 |
| F-statistic | 3404.112 | Durbin-Watson stat | 0.504045 |
| Prob(F-statistic) | 0.000000 | | |

Dependent Variable: PM33
Method: Fully Modified Least Squares (FMOLS)
Date: 04/21/11 Time: 19:41
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| E01 | 0.081378 | 0.254080 | 0.320285 | 0.7497 |
| IPIEZ33 | -0.202022 | 0.217160 | -0.930293 | 0.3555 |
| PPIEZ33 | -0.356575 | 1.358955 | -0.262389 | 0.7938 |
| PPIVS | 4.736229 | 0.940658 | 5.035016 | 0.0000 |
| C | -15.44324 | 2.604958 | -5.928402 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.960115 | Mean dependent var | 3.580364 |
| Adjusted R-squared | 0.957803 | S.D. dependent var | 0.453523 |
| S.E. of regression | 0.093163 | Sum squared resid | 0.598869 |
| Durbin-Watson stat | 0.796922 | Long-run variance | 0.018241 |

Cointegration Test - Engle-Granger
Date: 05/10/11 Time: 15:34
Equation: EQ33
Specification: PM33 E01 IPIEZ33 PPIEZ33 PPIVS C
Cointegrating equation deterministics: C
Null hypothesis: Series are not cointegrated
Automatic lag specification (lag=0 based on Akaike Info Criterion, maxlag=1)

| | Value | Prob.* |
|---|---|---|
| Engle-Granger tau-statistic | -4.181692 | 0.1203 |
| Engle-Granger z-statistic | -28.57611 | 0.1083 |

*MacKinnon (1996) p-values.

| Intermediate Results: | |
|---|---|
| Rho - 1 | -0.386164 |
| Rho S.E. | 0.092346 |
| Residual variance | 0.004906 |
| Long-run residual variance | 0.004906 |
| Number of lags | 0 |
| Number of observations | 74 |
| Number of stochastic trends** | 5 |

**Number of stochastic trends in asymptotic distribution.

Engle-Granger Test Equation:
Dependent Variable: D(RESID)
Method: Least Squares
Date: 05/10/11 Time: 15:34
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| RESID(-1) | -0.386164 | 0.092346 | -4.181692 | 0.0001 |

| | | | |
|---|---|---|---|
| R-squared | 0.193250 | Mean dependent var | 4.45E-05 |
| Adjusted R-squared | 0.193250 | S.D. dependent var | 0.077980 |
| S.E. of regression | 0.070041 | Akaike info criterion | -2.466052 |
| Sum squared resid | 0.358119 | Schwarz criterion | -2.434916 |
| Log likelihood | 92.24392 | Hannan-Quinn criter. | -2.453631 |
| Durbin-Watson stat | 2.020197 | | |

Dependent Variable: PM33
Method: Fully Modified Least Squares (FMOLS)
Date: 05/10/11 Time: 15:35
Sample (adjusted): 2002M02 2007M12
Included observations: 71 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth
= 4.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| E01(-3) | 0.396458 | 0.251609 | 1.575693 | 0.1199 |
| IPIEZ33 | -0.171443 | 0.191405 | -0.895711 | 0.3737 |
| PPIEZ33 | -0.576543 | 1.321369 | -0.436323 | 0.6640 |
| PPIVS | 5.095783 | 0.958528 | 5.316258 | 0.0000 |
| C | -16.15227 | 2.306596 | -7.002642 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.960794 | Mean dependent var | 3.615750 |
| Adjusted R-squared | 0.958417 | S.D. dependent var | 0.427977 |
| S.E. of regression | 0.087272 | Sum squared resid | 0.502686 |
| Durbin-Watson stat | 0.918970 | Long-run variance | 0.013806 |

Cointegration Test - Engle-Granger
Date: 05/10/11 Time: 15:35
Equation: EQ33
Specification: PM33 E01(-3) IPIEZ33 PPIEZ33 PPIVS C
Cointegrating equation deterministics: C
Null hypothesis: Series are not cointegrated
Automatic lag specification (lag=0 based on Akaike Info Criterion, maxlag=1)

| | Value | Prob.* |
|---|---|---|
| Engle-Granger tau-statistic | -4.978962 | 0.0213 |
| Engle-Granger z-statistic | -34.33497 | 0.0332 |

*MacKinnon (1996) p-values.

| Intermediate Results: | |
|---|---|
| Rho - 1 | -0.483591 |
| Rho S.E. | 0.097127 |
| Residual variance | 0.004683 |
| Long-run residual variance | 0.004683 |
| Number of lags | 0 |
| Number of observations | 71 |
| Number of stochastic trends** | 5 |

**Number of stochastic trends in asymptotic distribution.

Engle-Granger Test Equation:
Dependent Variable: D(RESID)
Method: Least Squares
Date: 05/10/11 Time: 15:35
Sample (adjusted): 2002M02 2007M12
Included observations: 71 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| RESID(-1) | -0.483591 | 0.097127 | -4.978962 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.260947 | Mean dependent var | 0.002213 |
| Adjusted R-squared | 0.260947 | S.D. dependent var | 0.079601 |
| S.E. of regression | 0.068432 | Akaike info criterion | -2.511970 |
| Sum squared resid | 0.327805 | Schwarz criterion | -2.480101 |
| Log likelihood | 90.17493 | Hannan-Quinn criter. | -2.499297 |
| Durbin-Watson stat | 2.065059 | | |

| | | | |
|---|---|---|---|
| S.E. of regression | 0.138404 | Akaike info criterion | -1.065415 |
| Sum squared resid | 1.360061 | Schwarz criterion | -0.941816 |
| Log likelihood | 43.95306 | Hannan-Quinn criter. | -1.016063 |
| Durbin-Watson stat | 0.544141 | | |

Dependent Variable: PM54
Method: Fully Modified Least Squares (FMOLS)
Date: 05/10/11 Time: 15:28
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ54 | -0.696540 | 0.472839 | -1.473102 | 0.1453 |
| E01 | -0.974566 | 0.494983 | -1.968886 | 0.0530 |
| PPIEZ54 | 8.739898 | 2.106840 | 4.148345 | 0.0001 |
| PPIVS | -2.943096 | 1.444210 | -2.037859 | 0.0454 |
| C | -12.78124 | 4.102826 | -3.115229 | 0.0027 |

| | | | |
|---|---|---|---|
| R-squared | 0.531353 | Mean dependent var | 10.92748 |
| Adjusted R-squared | 0.504186 | S.D. dependent var | 0.319736 |
| S.E. of regression | 0.225139 | Sum squared resid | 3.497441 |
| Durbin-Watson stat | 1.756466 | Long-run variance | 0.052414 |

Cointegration Test - Engle-Granger
Date: 05/10/11 Time: 15:37
Equation: EQ54
Specification: PM54 IPIEZ54 E01 PPIEZ54 PPIVS C
Cointegrating equation deterministics: C
Null hypothesis: Series are not cointegrated
Automatic lag specification (lag=0 based on Akaike Info Criterion, maxlag=1)

| | Value | Prob.* |
|---|---|---|
| Engle-Granger tau-statistic | -7.892539 | 0.0000 |
| Engle-Granger z-statistic | -66.80627 | 0.0000 |

*MacKinnon (1996) p-values.

| Intermediate Results: | |
|---|---|
| Rho - 1 | -0.902787 |
| Rho S.E. | 0.114385 |
| Residual variance | 0.044789 |
| Long-run residual variance | 0.044789 |
| Number of lags | 0 |
| Number of observations | 74 |
| Number of stochastic trends** | 5 |

**Number of stochastic trends in asymptotic distribution.

Engle-Granger Test Equation:
Dependent Variable: D(RESID)
Method: Least Squares
Date: 05/10/11 Time: 15:37
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| RESID(-1) | -0.902787 | 0.114385 | -7.892539 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.460302 | Mean dependent var | 0.004359 |
| Adjusted R-squared | 0.460302 | S.D. dependent var | 0.288077 |
| S.E. of regression | 0.211634 | Akaike info criterion | -0.254500 |
| Sum squared resid | 3.269579 | Schwarz criterion | -0.223364 |
| Log likelihood | 10.41649 | Hannan-Quinn criter. | -0.242079 |
| Durbin-Watson stat | 2.053072 | | |

Dependent Variable: PM54
Method: Fully Modified Least Squares (FMOLS)
Date: 05/10/11 Time: 16:39
Sample (adjusted): 2002M02 2007M12
Included observations: 71 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ54 | -0.468380 | 0.463152 | -1.011288 | 0.3156 |
| E01(-3) | -0.879703 | 0.559836 | -1.571358 | 0.1209 |
| PPIEZ54 | 8.697289 | 2.326259 | 3.738745 | 0.0004 |
| PPIVS | -2.945076 | 1.676518 | -1.756663 | 0.0836 |
| C | -13.59120 | 4.150819 | -3.274342 | 0.0017 |

| | | | |
|---|---|---|---|
| R-squared | 0.534671 | Mean dependent var | 10.94266 |
| Adjusted R-squared | 0.506469 | S.D. dependent var | 0.311748 |
| S.E. of regression | 0.219008 | Sum squared resid | 3.165661 |
| Durbin-Watson stat | 1.911672 | Long-run variance | 0.050053 |

Specification: PM54 IPIEZ54 E01(-3) PPIEZ54 PPIVS C
Cointegrating equation deterministics: C
Null hypothesis: Series are not cointegrated
Automatic lag specification (lag=0 based on Akaike Info Criterion, maxlag=1)

| | Value | Prob.* |
|---|---|---|
| Engle-Granger tau-statistic | -8.184451 | 0.0000 |
| Engle-Granger z-statistic | -68.69595 | 0.0000 |

*MacKinnon (1996) p-values.

| Intermediate Results: | |
|---|---|
| Rho - 1 | -0.967549 |
| Rho S.E. | 0.118218 |
| Residual variance | 0.043434 |
| Long-run residual variance | 0.043434 |
| Number of lags | 0 |
| Number of observations | 71 |
| Number of stochastic trends** | 5 |

**Number of stochastic trends in asymptotic distribution.

Engle-Granger Test Equation:
Dependent Variable: D(RESID)
Method: Least Squares
Date: 05/10/11 Time: 15:38
Sample (adjusted): 2002M02 2007M12
Included observations: 71 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| RESID(-1) | -0.967549 | 0.118218 | -8.184451 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.488926 | Mean dependent var | -0.003395 |
| Adjusted R-squared | 0.488926 | S.D. dependent var | 0.291524 |
| S.E. of regression | 0.208409 | Akaike info criterion | -0.284646 |
| Sum squared resid | 3.040396 | Schwarz criterion | -0.252777 |
| Log likelihood | 11.10494 | Hannan-Quinn criter. | -0.271973 |
| Durbin-Watson stat | 2.015259 | | |

Dependent Variable: PM78
Method: Fully Modified Least Squares (FMOLS)
Date: 05/10/11 Time: 16:27
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ78 | 0.206263 | 0.058853 | 3.504701 | 0.0008 |
| PPIEZ78 | -0.684456 | 0.330517 | -2.070867 | 0.0421 |
| PPIVS | -0.176627 | 0.218889 | -0.806924 | 0.4225 |
| E01 | -0.691943 | 0.059032 | -11.72151 | 0.0000 |
| C | 10.35848 | 0.629834 | 16.44635 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.839986 | Mean dependent var | 7.478773 |
| Adjusted R-squared | 0.830710 | S.D. dependent var | 0.070930 |
| S.E. of regression | 0.029184 | Sum squared resid | 0.058768 |
| Durbin-Watson stat | 1.597129 | Long-run variance | 0.000927 |

Cointegration Test - Engle-Granger
Date: 05/10/11 Time: 16:28
Equation: EQ78
Specification: PM78 IPIEZ78 PPIEZ78 PPIVS E01 C
Cointegrating equation deterministics: C
Null hypothesis: Series are not cointegrated
Automatic lag specification (lag=0 based on Akaike Info Criterion, maxlag=1)

| | Value | Prob.* |
|---|---|---|
| Engle-Granger tau-statistic | -7.077873 | 0.0000 |
| Engle-Granger z-statistic | -59.51581 | 0.0000 |

*MacKinnon (1996) p-values.

| Intermediate Results: | |
|---|---|
| Rho - 1 | -0.804268 |
| Rho S.E. | 0.113631 |
| Residual variance | 0.000744 |
| Long-run residual variance | 0.000744 |
| Number of lags | 0 |
| Number of observations | 74 |
| Number of stochastic trends** | 5 |

**Number of stochastic trends in asymptotic distribution.

Engle-Granger Test Equation:
Dependent Variable: D(RESID)
Method: Least Squares
Date: 05/10/11 Time: 16:28
Sample (adjusted): 2001M11 2007M12
Included observations: 74 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| RESID(-1) | -0.804268 | 0.113631 | -7.077873 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.406939 | Mean dependent var | 0.000246 |
| Adjusted R-squared | 0.406939 | S.D. dependent var | 0.035419 |
| S.E. of regression | 0.027276 | Akaike info criterion | -4.352190 |
| Sum squared resid | 0.054311 | Schwarz criterion | -4.321054 |
| Log likelihood | 162.0310 | Hannan-Quinn criter. | -4.339769 |
| Durbin-Watson stat | 2.026686 | | |

Dependent Variable: PM78
Method: Fully Modified Least Squares (FMOLS)
Date: 05/10/11 Time: 16:29
Sample (adjusted): 2002M02 2007M12
Included observations: 71 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IPIEZ78 | 0.258348 | 0.101756 | 2.538888 | 0.0135 |
| PPIEZ78 | -0.963123 | 0.603499 | -1.595898 | 0.1153 |
| PPIVS | 0.104411 | 0.413002 | 0.252810 | 0.8012 |
| E01(-3) | -0.518242 | 0.108608 | -4.771694 | 0.0000 |
| C | 10.15890 | 1.090452 | 9.316226 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.564661 | Mean dependent var | 7.485085 |
| Adjusted R-squared | 0.538277 | S.D. dependent var | 0.065040 |
| S.E. of regression | 0.044195 | Sum squared resid | 0.128911 |
| Durbin-Watson stat | 1.118578 | Long-run variance | 0.002647 |

Cointegration Test - Engle-Granger
Date: 05/10/11 Time: 16:29
Equation: EQ78
Specification: PM78 IPIEZ78 PPIEZ78 PPIVS E01(-3) C
Cointegrating equation deterministics: C
Null hypothesis: Series are not cointegrated
Automatic lag specification (lag=0 based on Akaike Info Criterion, maxlag=1)

| | Value | Prob.* |
|---|---|---|
| Engle-Granger tau-statistic | -5.171281 | 0.0131 |
| Engle-Granger z-statistic | -39.23900 | 0.0107 |

*MacKinnon (1996) p-values.

Intermediate Results:

| | |
|---|---|
| Rho - 1 | -0.552662 |
| Rho S.E. | 0.106871 |
| Residual variance | 0.001451 |
| Long-run residual variance | 0.001451 |
| Number of lags | 0 |
| Number of observations | 71 |
| Number of stochastic trends** | 5 |

**Number of stochastic trends in asymptotic distribution.

Engle-Granger Test Equation:
Dependent Variable: D(RESID)
Method: Least Squares
Date: 05/10/11 Time: 16:29
Sample (adjusted): 2002M02 2007M12
Included observations: 71 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| RESID(-1) | -0.552662 | 0.106871 | -5.171281 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.276419 | Mean dependent var | 0.000150 |
| Adjusted R-squared | 0.276419 | S.D. dependent var | 0.044788 |
| S.E. of regression | 0.038098 | Akaike info criterion | -3.683303 |
| Sum squared resid | 0.101604 | Schwarz criterion | -3.651435 |
| Log likelihood | 131.7573 | Hannan-Quinn criter. | -3.670630 |
| Durbin-Watson stat | 1.929294 | | |

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