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MARKET POWER AND PURCHASING POWER PARITY:  
A GENERAL EQUILIBRIUM MODEL

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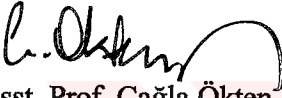
September 2004

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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## **ABSTRACT**

### **MARKET POWER AND PURCHASING POWER PARITY: A GENERAL EQUILIBRIUM MODEL**

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September, 2004**

In this thesis, the effect of market power on exchange rate is analyzed in a general equilibrium Lucas's tree type model. The basic hypothesis that explains the level of the exchange rate is the Purchasing Power Parity (PPP), which predicts that money has the same purchasing power in each country. Research on exchange rates and goods prices has moved to an examination of the importance of imperfect competition in international markets. In the field of international economics, models of imperfect competition have been proposed to explain the response of import and import-competing prices to exchange rate changes. In this study imperfectly competitive relation between foreign and domestic firms is investigated under market power. Our theoretical analysis defines and measures the effects of market power on export and import prices and their relative amounts. Our results indicate that market power affects the composition of a country's consumption in terms of import and domestically produced goods because of the effect on the prices at home and abroad.

**Keywords:** Market Power, Purchasing Power Parity, Imperfect Competition

## ÖZET

### PAZAR GÜCÜ VE SATINALMA PARİTESİ: BİR GENEL DENGİ MODELİ

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Bu tezde, bütçe sınırlı Lucas ağaç modeli kullanılarak pazar gücünün döviz kurlarına olan etkisi bir denge modelinde incelenmiştir. Döviz kuru seviyesini açıklayan en temel hipotez, paranın her ülkede aynı miktarda mal alması gerektiğini öne süren satınalma gücü paritesidir. Döviz kurları üstündeki çalışmalar uluslararası piyasalarda eksik rekabetin önemini inceleyen bir yöne doğru kaymıştır. Uluslararası iktisat alanında, döviz kurlarındaki değişim sonucu ithal ve yerel malların fiyatlarındaki tepkileri açıklamak için eksik rekabet modelleri kurulmuştur. Bu çalışmada yerel ve yabancı firmaların eksik rekabet ortamdaki ilişkisi pazar gücü adı altında incelenmiştir. Yaptığımız bu teorik analiz, pazar gücünün ihraç ve ithal malların fiyat ve bağıl tüketim oranlarını bulur. Bulduğumuz sonuçlar, pazar gücünün bir ülkenin tüketim kalemindeki malların yerel ve ithal cinsinden bağıl tüketim oranları konusunda belirleyici olduğunu göstermiştir.

Anahtar Kelimeler: Pazar Gücü, Satınalma Paritesi, Eksik Rekabet

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## CHAPTER 1

### INTRODUCTION

The basic hypothesis that explains the level of the exchange rate is the Purchasing Power Parity (PPP), which predicts that money has the same purchasing power in each country. Thus if one dollar buys roughly 1,400,000 TL<sup>1</sup> as in 2004; then according to the PPP hypothesis, the one dollar would purchase the same quantity of goods in United States that the 1,400,000 TL would in Turkey. Another way to express the same idea is that the price level is the same in all currencies, converted at the ruling exchange rate. Purchasing power parity is defined under two subtitles:

i- Absolute purchasing power parity means that the exchange rate is equal to the ratio of two national price levels. An equilibrium exchange rate is such that two currencies purchase the same amount of goods and services in the two economies. Let  $p$  denote the home currency price level,  $p^*$  the home currency price in a different country, and  $e$  the exchange rate of initial country's currency per unit of latter one's. Absolute purchasing power parity theory of exchange rates implies that:

$$p = ep^*$$

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<sup>1</sup> A rough average value for 2004

The existence of absolute PPP hinges upon the lack of frictions across economies. The transportation, distribution and resale of goods must be costless for absolute purchasing power parity to be insured. Because these assumptions are unlikely to hold in practice, the absolute version is modified.

ii- Relative purchasing power parity implies that changes in the exchange rate are equal to changes in relative national price levels. Suppose that the above frictions give rise to a stable price differential across two markets. In this case, we have:

$$p = \alpha e p^*$$

where  $\alpha$  is the real exchange rate or, alternatively,  $(\alpha \times 100)$  is the home currency price level as a percentage of the foreign. If  $\alpha$  remains constant over time, then common currency prices change in the same way over time in two countries, and the relative purchasing power parity holds.

A further extension, the 'law of one price' states that the domestic market price depends on the world market price of the good in domestic currency plus the proportional tariff levied on the product by domestic government and the cost of transporting the product to the domestic market. In this study we examine how variations of the degree of market power of a good across countries can cause deviations of the exchange rate away from PPP.

## **CHAPTER 2**

### **HISTORY**

This chapter begins with the history of ideas on exchange rates and continues with a survey of theoretical and empirical studies. The causes of fluctuations in real exchange rates and deviations from the Purchasing Power Parity are examined. The chapter ends with the uses of this hypothesis and its application in modern view.

PPP is one of the oldest and also one of the most controversial doctrines in economics. Scholars of the Salamanca School in sixteenth century Spain first articulate it as an empirical proposition which states that national price levels should be equal when converted to a common currency( Kenneth Rogoff 1996). Prior to World War I most countries adhered to gold standard stating that different currencies were convertible to gold at fixed parities. For later times, Rogoff (1996:648) points out that:

After the outbreak of World War I; the world financial system and the gold standard collapsed because returning to the prewar exchange rates was impossible due to vastly differing inflation experiences during the war. Besides, speculators became concerned that countries would devalue their currencies to gain seignorage revenues.

The debate on restoring the financial system pointed the modern origins of purchasing power parity. Gustav Cassel, the Swedish economist proposed calculating cumulative Consumer Price Index inflation rates from the beginning of 1914 and use these inflation differentials to calculate the exchange rate that satisfy the PPP (For a summery of Cassel's work see Officer, 1976). Even though there has always been a debate on holding of PPP hypothesis alternative explanations could not have been presented for a long time. The very high volatility of real exchange rates during 1970s float refuted the Purchasing Power Parity Hypothesis and prelude of the alternatives - the hypothesis of random walk- became a popular field to be studied.

## **2.1 Empirical Findings**

There is a long-standing questioning of purchasing power parity. Some studies proposed the hypothesis of random walk (no convergence toward PPP) behavior in real exchange rates, which rejected the ability of models based on purchasing power parity hypothesis to provide a satisfactory explanation on exchange rates. If the real exchange rate is a random walk, then there is no long term equilibrium value to which the real exchange rate tends to return. In terms of time series characteristics, if real exchange rates are non-stationary, then PPP does not hold in the long run. Adler and Lehman (1983) have failed to reject the random walk hypothesis for exchange rates empirically, Rush and Husted (1985) have

found that purchasing power parity does not hold between Italy and Germany and between Italy and France, although it holds between France and Germany. These findings and the judgement could be explained by considering that exchange rates and their rates of change have been more volatile than relative price levels and rates of inflation. Even though Baillie and Selover (1987), Meese and Rogoff (1988), and Mark (1990) have rejected stationarity and long-run PPP, the ever-growing empirical literature has arrived a consensus on real exchange rates. They conclude that exchange rates tend toward PPP in the very long run.<sup>2</sup>

Developing statistical and econometric methods built a stronger long-run purchasing power parity hypothesis. Despite the objections emphasizing that the data period for recent float alone may be too short; Abuaf and Jorion (1990) increased the power of their tests by using larger time series and rejected the random walk hypothesis for the real exchange rate. Diebold, Husted and Rush (1991) have applied fractional integration techniques and found evidence of long run purchasing power parity. Whitt (1992) tested for both CPI and WPI of European countries, Japan and Australia and the results corroborated those of Abuaf and Jorion (1990) rejecting the random walk hypothesis. Huang (1990) decomposed the deviations into a forward exchange risk premium component and a percentage real interest rate differential component and concluded in his empirical study that deviations from purchasing power parity exhibit well-documented empirical regularity. Recent applied study on long-run purchasing power parity among major industrialized economies seem to be turning in favour

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<sup>2</sup> These studies include Whitt (1992), Abuaf and Jorion (1990) and Deloach(1997).

of long-run purchasing power parity hypothesis (e.g., MacDonald 1993).

## **2.2 Theoretical Explanation**

There are studies demonstrating that deviations from purchasing power parity are consistent with other theoretical explanations such as martingale behavior. Adler and Lehmann (1983) derived the Martingale model of PPP deviations, which was valid for both fixed and flexible exchange rate periods, for a wide variety of countries. This model proposed that the real exchange rate follows martingale, a stochastic process in which successive increments are unpredictable.

Meese and Rogoff (1988) have argued that shocks have a completely permanent effect on the levels of real exchange rates and the changes are unpredictable which supports the martingale explanation. However, the objection came with a very basic intuition by Diebold, Husted and Rush (1991: 1253-1254).

They argue that there is little or no tendency for nominal exchange rates and prices to adjust in such a way as to promote purchasing power parity. We find such a behavior of real exchange rate to be economically implausible. The real exchange rate is relative price. Accepting the hypothesis of nonstationarity of the real exchange rate implies that it can, and will, take on any value in finite time. The potential for such wide-ranging behavior of the relative price of one nation's goods seems unlikely.

This study posed a serious challenge to the opinion that deviations from PPP can be explained by martingales. MacDonald and Marsh (1997) adopted a simultaneous-equation modeling strategy to produce dynamic exchange rate

models which were shown to produce significantly better forecasts than the benchmark random walk. However Cassel's (1916) assertion that "monetary flows, affecting domestic prices would continue until parity is achieved" has been criticized for being unrealistic for various reasons which are discussed in the following sections.

### **2.2.1 Non-Traded Goods**

Many goods and services do not enter into international trade i.e. a haircut is classified as a non-tradable service between two countries. Balassa (1964) proposed that instead of attempting to rely on aggregate indexes, more attention should be paid to the behavior of sectoral indexes with appropriate separation in terms of tradable (agricultural and manufacturing) and non-tradable (service) goods and proposes that the deviation from PPP is expected potentially to be large for non-tradable goods and the relative price of the non-traded commodity will be higher in the country with higher productivity (or income) levels than in the other. Bergstrand (1991) answers the question whether equilibrium exchange rates vary systematically across countries and finds the evidence which suggests strongly that they do. "Prices tend to be higher in countries with higher per capita GDP, with higher capital/labor ratios and with greater differentials in labor productivity between tradeables and non-tradeables". Neary(1988) built the mathematical model of determinants of the equilibrium real exchange rate and his approach showed that a number of results in the literature on small open economies are special cases of a general phenomenon: "Changes in exogenous variables are more

likely to lead to a real appreciation the greater their effect on the demand for and the smaller their effect on the supply of nontraded relative to traded goods."

### **2.2.2 Taxation, Transportation and Other Frictions**

Absolute PPP theory is well known to be incorrect for three reasons observable in practical life. First is indirect taxation: new cars cost more in Turkey than in other European countries because they are more heavily taxed in Turkey.<sup>3</sup> The second reason is the trade barriers set by government and third one is transportation costs. Dornbusch (1988) pointed out that: "The thought that PPP governs exchange rates is only appropriate to a world where equilibrium relative prices never change. If they change a lot because real disturbances are large, then PPP is best forgotten."<sup>4</sup> Besides, Aizenman's (1984) theoretical model integrated deviations from purchasing power parity with an analysis of the determinants of the exchange rate which considers the transaction costs and states that purchasing power parity should hold better between neighboring countries and between countries with larger potential trade. Parsley and Shang-Jin Wei (1996) determined the rate of convergence to PPP to be higher among cities in the United States, which are without trade barriers than cross countries.

### **2.2.3 Government Spending**

Some popular empirical theory of the real exchange rate concludes that sustained current account deficits are associated with long-run real exchange rate depreciation. Krugman (1990) argues that current accounts are likely to induce

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<sup>3</sup> Ö.T.V. tax on V.A.T. is 27% to 50 % by law 12/06/2002.

<sup>4</sup> This conclusion is supported in 1980s.

significant real exchange rate changes because they lead to transfers of wealth across countries. Another consideration that is sometimes emphasized in making adjustments to purchasing power parity is the level of government spending. Froot and Rogoff (1991) found that government spending is a significant determinant of the real exchange rate. They reason that this effect is observed because relative to private spending, government spending tends to fall more heavily on non-traded goods. Therefore a rise in government spending leads to an increase in the real exchange rate .

### **2.3 Uses of PPP**

Today PPP is applied by policymakers to many problems i.e. determining the initial exchange rate for a newly independent country, forecasting the long run exchange rates, adjusting the price differentials in international comparisons of income etc. Researchers also use it to compare income levels across countries. Even if short-run deviations from purchasing power parity are large and volatile, it is a more useful way of comparing international living standards than market exchange rate, which is more volatile.

## **CHAPTER 3**

### **EXCHANGE RATE MODELS**

This chapter contains the discussion of short run and long run behavior of exchange rates and a brief review of the models that explain the determination of level of exchange rates.

#### **3.1 Long-Run& Short-Run**

Purchasing power parity has variously been viewed as a theory of exchange rate determination weakly as a short, but more strongly as a long run equilibrium condition in asset markets. The literature on exchange rates has been focused on a problem: The question is whether equilibrium real exchange rates revert to equilibrium in the long run. PPP theory suggests that the answer is yes, but the empirical study on this proposition has faced many problems. The reason is that the equilibrium real exchange rate is not constant over time, for the trade protection level may differ over time or the relative price levels among countries may also change.

Before 1970s the initial general belief on purchasing power parity supported the existence of a fairly stable exchange rate (e.g., Friedman and Schwartz 1963). In these studies Keynesian models were generally used as the

macroeconomic model and the developed version is the famous Mundell-Fleming model that integrated asset markets and capital mobility into open-economy macroeconomics. The monetary model explanation based on flexible price assumes continuous purchasing power parity and defines the exchange rate as the relative price of two monies. The model defines relative price in terms of relative supply and demand of those monies. The demand for money is assumed to depend on real income, the price level, and the level of the nominal interest rate. An important assumption in the flexible price monetary model is continuous purchasing power parity; the domestic money supply determines the domestic price level and hence the exchange rate is determined by relative money supplies. The very high volatility of real exchange rates during 1970s float, conspicuously refuting the assumption of continuous purchasing power parity, led to the development of three further classes of models; sticky price monetary models, equilibrium models and portfolio balance model.

### **3.1.1 Sticky Price Models**

Sticky price monetary models, e.g. Dornbusch (1976), allow short-term overshooting of the nominal and real exchange rates above their long-run equilibrium levels. Assume that there is a cut in the nominal domestic money supply, there will occur an initial fall in the real money supply and a consequent rise in interest rates in order to clear the money market since goods prices are sticky in the short run. A capital inflow and appreciation of the nominal exchange

rate will occur because of the rise in domestic interest rates. Investors are aware of a risk that they may suffer a foreign exchange loss when they are repaying liabilities in foreign currency for the value of the domestic currency is artificially high. However, risk neutral investors will continue to borrow from abroad and use it to buy domestic assets, so long as the expected foreign exchange loss (expected rate of depreciation) is less than the known capital market gain (the interest differential). A short-run equilibrium is achieved when the expected rate of depreciation is just equal to the interest differential. Because the expected rate of depreciation is related with interest rate differential, the exchange rate must have overshoot its long-run equilibrium (purchasing power parity level). In the medium run, however, domestic prices begin to fall in response to the fall in money supply. This alleviates pressure in the money market (the real money supply rises) and domestic interest rates begin to decline. The exchange rate then depreciates slowly to long-run purchasing power parity.

### **3.1.2 General Equilibrium Models**

Equilibrium exchange rate models are developed originally by Alan Stockman (1980) and Robert Lucas (1982). These studies analyze the general equilibrium of a two country model. They assume agents holding local currency (the accepted medium of exchange to purchase goods) and maximize the expected present value of a representative agent's utility, subject to budget and cash-in-

advance constraints. In an important sense, equilibrium models are an extension, or generalization of the flexible price monetary models to allow for multiple traded goods and real shocks across countries. A simple equilibrium model can be sketched by considering a two-country, two-good world in which prices are flexible and markets are in equilibrium, as in the flexible-price monetary model. In contrast to the monetary model, agents distinguish between domestic and foreign goods in terms of well-defined preferences. Stockman's (1980) theoretical model proposed that deviations from purchasing power parity and exchange rate volatility can be consistent with equilibrium,

### **3.1.3 The Portfolio Balance Model**

The key distinguishing feature of the portfolio balance model approach to exchange rate is the assumed imperfect substitutability between domestic and foreign assets. Wealth is divided into three components: money, domestically issued bonds and foreign bonds. Trade balance depends positively on the level of the real exchange rate and an open market purchase of domestic bonds result in a fall of domestic interest rate and a depreciation of domestic currency, Taylor (1995). The extent of empirical study on this model is much less than the monetary class of models because of the problems in mapping theoretical portfolio balance models into real world financial data.

## **CHAPTER 4**

### **MARKET POWER MODEL**

This chapter introduces our model and continues with the calibration results and a discussion. The market power is defined and export-import, domestic-foreign price equations are presented in this chapter, and are followed by the results of the calibration and discussion of the major findings from these estimations.

Fitoussi and Le Cacheux (1988) criticized floating exchange rates for demonstrating large and persistent movements in currency values, both nominal and real, with apparently no tendency for purchasing power parity to assert itself either in the aggregate or on a product basis. There is growing evidence that ‘the law of one price’ does not seem to hold even for tradable goods and price-cost markups display large and persistent fluctuations. Research on exchange rates and goods prices has moved to an examination of the importance of imperfect competition in international markets (Goldberg and Knetter 1997). The imperfectly competitive relation between foreign and domestic firms can be investigated under market power. Market power occurs when one buyer or seller in a market has ability to exert significant influence over the price or quantity of goods and services traded. Simply, market power does not exist when there is perfect

competition but it does when there is a monopoly or oligopoly. It is worth here to emphasize the relation between integration and segmentation and the nature of competition. Any perfectly competitive market is characterized by the condition that price equals marginal cost. Therefore a perfectly competitive market must be integrated (geography or nationality do not have systematic effects on transaction prices).

A segmented market (i.e., where location of buyers and sellers influences the terms of the transaction by more than the marginal cost of physically moving the good from one location to another) implies the existence of market power; because buyers face different prices, not all buyers face a price equal to marginal cost (Goldberg and Knetter 1997). In the field of international economics, models of imperfect competition have been proposed to explain the response of import and import-competing prices to exchange rate changes.<sup>5</sup> Knetter(1993) finds that a monopolist that price discriminates across export destinations reduces markup to buyers whose currencies have depreciated against the seller. In the case of countries managing their exchange rate, it also suggests that if some kind of purchasing power parity or relative cost parity policy is pursued, it may lead to sustained trade imbalances (Fitoussi and Le Cacheux 1988). Knetter (1989) claimed accounts of U.S. experience cite the failure of dollar prices of imported goods to rise in proportion to exchange rates (i.e. incomplete pass through) as an important factor in explaining the persistence of the trade deficit. This is a case that may characterize the current situation in Turkey by 2004.

Hazledine (1980) proposed a model, which is termed the 'market power

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<sup>5</sup> See for example, Dornbusch, 1987

model', and tested both it and the law of one price against some cross-sectional data on differences between Canadian and US prices. The market-power model fitted the data rather better than the law of one price. In the model the assumption that imports are perfect substitutes for domestic output is dropped. In the market power pricing model of Hazledine (1980); domestic price is determined as a weighted sum of domestic cost and substitute price in addition to entry-barrier factors (tariff and transportation costs) which are included in the law of one price model. Dornbusch (1987) explained the adjustment of relative prices to exchange rate movements in an industrial organization approach with the prediction that appreciation should lead to a decline in the price of imports. The extent of price adjustment is shown to depend on product substitutability, the relative number of domestic and foreign firms, and market structure. In the case of homogeneous goods, domestic firms fully match the decline in price. If products are differentiated relative price of the imported brands declines in response to an appreciation. The extent of the decline depends on a measure of competition and on the relative number of home and foreign firms.

#### **4.1 The Model**

I consider a two-country and two-good world. Each country is specialized in the production of one good, which can be consumed domestically or sold in the other country. The representative consumer in each country consumes both goods. This is a Lucas' tree type model, meaning that production is

exogenous in each country. I assume that ownership of the production process is restricted to be held domestically. I also imagine that the household consists of a worker-shopper pair. The worker sells the tree's output while the shopper purchases in the market. The consumer receives a dividend from ownership of the firms. This dividend consists of domestic currency for locally sold goods and foreign currency for exported goods.

#### 4.1.1 The Consumer's Problem

Country A specializes in the production of good 1 and country B specializes in the production of good 2. Since each country's problem is symmetric to the other, I will focus on A's problem. Superscripts delineate the country and subscripts delineate the good. The superscript A has been suppressed for clarity. Country A's representative consumer is subject to a budget constraint. The consumer's budget constraint is presented in real terms:

$$\bar{p}_1 \cdot c_1 + \bar{p}_2 \cdot c_2 = p_1 \cdot (y - x) + \frac{p_1^B \cdot x}{e} \quad (1)$$

The left hand side of equation (1) shows how the consumer allocates his wealth. The consumer consumes the domestically produced good and the foreign good. Both goods are priced in domestic currency. A portion of output,  $x$ , is

exported to country B and the remaining,  $y-x$ , is sold locally. The first term on the right side represents revenue from domestic sales. The second term represents revenue from exports as the foreign spending on good 1, converted into domestic currency using the market exchange rate,  $e$ .

In equilibrium the following equilibrium conditions should apply:

$$\begin{aligned}
 c_1 + x &\leq y \\
 x^B + c_2^B &\leq y^B \\
 x &= c_1^B, \quad x^B = c_2 \\
 \bar{p}_i^j &= p_i^j, \quad i = \{1, 2\}, j = \{A, B\}
 \end{aligned} \tag{2}$$

The first two lines imply that a country can consume and export less than or equal to its output level. Note that good 1 is produced only by country A and good 2 is produced only by country B. Since the output is either consumed domestically or exported, the export level of one country should be equal to foreign good (import) consumption of the other country.

### 4.1.2 Optimization

Both the domestic and foreign produced goods enter the utility function, providing a motive for foreign trade. I assume the following utility function:

$$\begin{aligned}
 u(c_1, c_2) &= \frac{1}{1-\psi} \cdot (c_1^\alpha \cdot c_2^{1-\alpha})^{1-\psi}, \quad \psi \neq 1 \\
 &= \alpha \ln(c_1) + (1-\alpha) \ln(c_2), \quad \psi = 1
 \end{aligned} \tag{3}$$

By placing market-clearing conditions in the budget constraint we can find:

$$e = \frac{p_1^B \cdot c_1^B}{p_2 \cdot c_2} \tag{4}$$

Note that in stationary equilibrium the exchange rate supports trade balance.

The consumer's problem can be posed as a Lagrangian equation problem:

$$\ell = \max_{c_1, c_2, x} \left\{ u(c_1, c_2) + \lambda \cdot \left( p_1 \cdot (y - x) + \frac{p_1^B \cdot x}{e} - \bar{p}_1 \cdot c_1 - \bar{p}_2 \cdot c_2 \right) \right\} \tag{5}$$

which is subject to the budget constraint and market clearing conditions. The consumer selects consumption levels of both goods and the level of exports subject to his budget constraint. The first order conditions are:

$$\ell_{c_1} = u_1 - \bar{p}_1 \cdot \lambda = 0 \quad (6)$$

$$\ell_{c_2} = u_2 - \bar{p}_2 \cdot \lambda = 0 \quad (7)$$

$$\ell_x = \left[ \frac{p_1^B}{e} + \frac{\partial p_1^B}{\partial x} \cdot \frac{x}{e} - p_1 + \frac{\partial p_1}{\partial x} \cdot (y - x) \right] \cdot \lambda = 0 \quad (8)$$

Here, the firm potentially has market power. The price is a function of the quantity sold in each market. Combining equations 6 and 7, I obtain the following optimal condition governing the total spending on goods 1 and 2:

$$p_1 \cdot c_1 = \frac{\alpha}{1 - \alpha} \cdot p_2 \cdot c_2 \quad (9)$$

### 4.1.3 Introducing Market Power

The innovation of this paper is to introduce market power. Let us define the following market power parameters:

$$\Theta_1 = \left[ 1 + \frac{\partial p_1^B}{\partial c_1^B} \cdot \frac{c_1^B}{p_1^B} \right] \left[ 1 + \frac{\partial p_1}{\partial c_1} \cdot \frac{c_1}{p_1} \right]^{-1} \quad (10)$$

$$\Theta_2 = \left[ 1 + \frac{\partial p_2^B}{\partial c_2^B} \cdot \frac{c_2^B}{p_2^B} \right] \left[ 1 + \frac{\partial p_2}{\partial c_2} \cdot \frac{c_2}{p_2} \right]^{-1} \quad (11)$$

The terms  $\Theta_i, i = \{1, 2\}$  represents the market power of good  $i$  in country B relative to country A. If the parameter is one then the market power is the same in each country's market. This could be perfect competition in each market, but it does not have to be. Values of  $\Theta_i$  between 0 and 1 imply that there is more market power in country B's market, so the price is higher in B hence there is less consumption there and more in country A. Values between 1 and infinity, imply that there is more market power in country A, so there is higher prices in A.

For the purposes of this paper I assume that  $\Theta_i$  are exogenously determined.

First consider the case in which good is sold in perfectly competitive markets in each country. In this case  $\Theta_i = 1$  and purchasing power parity holds for the good. More generally  $\Theta_i = 1$  does not imply that each market is competitive, it would be preferable to derive  $\Theta$  endogenously within the model by allowing for multiple firms to compete in each market in each country, however, this is beyond the scope of this paper.

The exchange rate can be represented as:

$$e = \frac{p_1^B}{p_1} \cdot \left[ 1 + \frac{\partial p_1^B}{\partial c_1^B} \cdot \frac{c_1^B}{p_1^B} \right] \left[ 1 + \frac{\partial p_1}{\partial c_1} \cdot \frac{c_1}{p_1} \right]^{-1} \quad (12)$$

We see here that if there is market power, i.e. if the price of a good responds to the quantity sold, then the exchange rate deviates from purchasing power parity.

We can now write the exchange rate from equation 12 as:

$$e = \frac{p_i^B}{p_i} \cdot \Theta_i, \quad i = \{1, 2\} \quad (13)$$

Therefore the degree of relative market power determines the amount of deviation from purchasing power parity for the good. At one extreme we have  $\Theta_i = 1$ . There is equal market power in each country's market for the good so purchasing power parity holds.

$$\Theta_i = 1 \quad (14)$$

### Country B's Problem:

I assume that country B's problem is symmetric to country A's problem. I do, however, allow for a different weighting in B's utility function:

$$\begin{aligned} u^B(c_1^B, c_2^B) &= \frac{1}{1-\psi} \cdot \left( (c_1^B)^\varphi \cdot (c_2^B)^{1-\varphi} \right)^{1-\psi}, \quad \psi \neq 1 \\ &= \varphi \ln(c_1^B) + (1-\varphi) \ln(c_2^B), \quad \psi = 1 \end{aligned} \tag{15}$$

The model has eleven unknowns. Four consumption levels, four prices, two Lagrange multipliers and the exchange rate are found by combining nine equations. The equations, which are listed in the Appendix, consist of the first order conditions for the consumer in each country, the budget constraints and the market clearing conditions.

I am free to pick two numeraire governing the absolute, as opposed to relative price level in each country. I selected the home good price in each country such that the goods prices have symmetric appearance across goods and countries.

$$c_1 = \frac{\alpha}{(1-\alpha) \cdot \Theta_1 + \alpha} \cdot y \tag{16}$$

$$c_2 = \frac{\varphi}{(1-\varphi) \cdot \Theta_2 + \varphi} \cdot y^B \tag{17}$$

$$c_1^B = \frac{(1-\alpha) \cdot \Theta_1}{(1-\alpha) \cdot \Theta_1 + \alpha} \cdot y \quad (18)$$

$$c_2^B = \frac{(1-\varphi) \cdot \Theta_2}{(1-\varphi) \cdot \Theta_2 + \varphi} \cdot y^B \quad (19)$$

$$p_1 = \frac{(1-\alpha) \cdot \Theta_1 + \alpha}{(1-\alpha) \cdot y}, \quad \text{numeraire} \quad (20)$$

$$p_1^B = \frac{e \cdot p_1}{\Theta_1} = \frac{(1-\alpha) \cdot \Theta_1 + \alpha}{(1-\alpha) \cdot y \cdot \Theta_1} \quad (21)$$

$$p_2 = \frac{(1-\varphi) \cdot \Theta_2 + \varphi}{\varphi \cdot y^B} \quad (22)$$

$$p_2^B = \frac{e \cdot p_2}{\Theta_2} = \frac{(1-\varphi) \cdot \Theta_2 + \varphi}{\varphi \cdot y^B \cdot \Theta_2} \quad \text{numeraire} \quad (23)$$

$$e = 1 \quad (24)$$

We can see from equation that purchasing power parity holds when the market power of a good is equal in different countries and  $e=1$  under our numeraire. Consumption is a share of output, with share given by utility function parameter  $\alpha$  or  $\varphi$  and price is decreasing in output. This includes the case of

competitive markets. A larger value of  $\Theta_i$ ,  $i = \{1,2\}$  means that; there is more market power in country A than in country B. When the seller has market power, he does not take the price levels as given hence price changes with quantity. Increasing  $\Theta_i$ ,  $i = \{1,2\}$  reduces the quantity sold in A's market in favor of B's. This drives up A's price of the good and reduces B's price. Country A residents benefit from low values of  $\Theta_i$ ,  $i = \{1,2\}$ .

#### 4.1.4 Real Exchange Rate

First let us examine the implicit exchange rate defined by looking at a single good. For each good, the real exchange rate for that good is defined:

$$r_i \equiv e \cdot \frac{p_i}{p_i^B} = \Theta_i, \quad i = \{1,2\} \quad (25)$$

Now moving to the market exchange rate, the real exchange rate defined by the trade-weighted average of goods is:

$$r = \prod_{i=1}^n (\Theta_i)^{w_i} \quad (26)$$

where  $w_i$  is the trade weight share of good  $i$ . We can rewrite this real market exchange rate as:

$$\ln r = \sum_{i=1}^n w_i \ln \Theta_i . \quad (27)$$

Perfect competition in every market implies that the real exchange rate is one. More generally, the real exchange rate will be one if the geometric weighted product of individual market powers is one. That is, if market power in one market is counter-balanced by a reciprocal weakness in another market. In our simple model the trade weight shares are equal at  $\frac{1}{2}$  for each good, so we observe  $r = 1$  if and only if  $\Theta_1 = \frac{1}{\Theta_2}$ . If the real exchange rate is smaller (larger) than one for a country then that country possesses an overall market power (weakness) relative to the other country.

Note that if we neglect to employ logs in equation 27, to obtain:

$$r = \sum_{i=1}^n w_i \cdot \Theta_i \quad (28)$$

then we may be introducing an apparent deviation from purchasing power parity where none actually exists. Consider our example above in which  $\Theta_1 = \frac{1}{\Theta_2}$ . Clearly we should obtain  $r = 1$ . However, if equation 29<sup>6</sup> is mistakenly used then:

$$r = \frac{1}{2} \cdot \Theta_1 + \frac{1}{2} \cdot \frac{1}{\Theta_1} \quad (29)$$

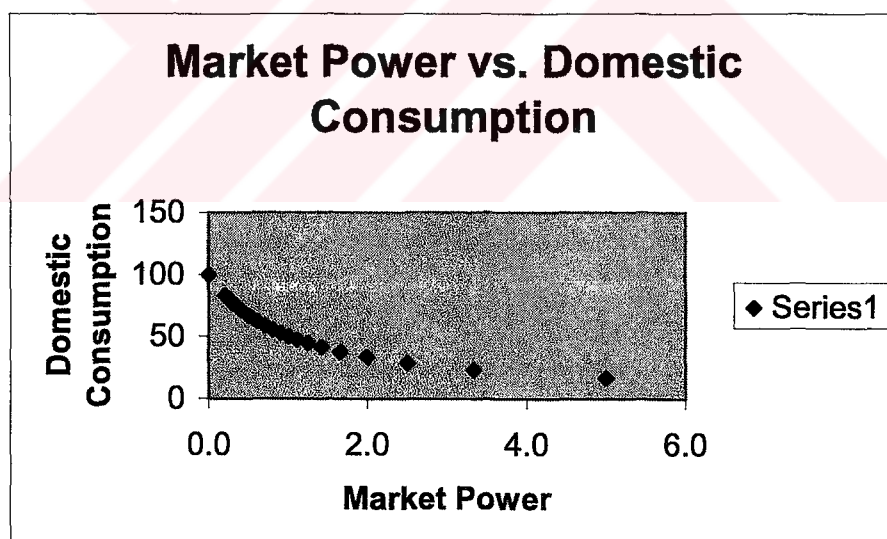
We would only conclude that  $r = 1$  if all markets were competitive. The use of equation 29 may introduce apparent deviations from purchasing power parity where none exist.

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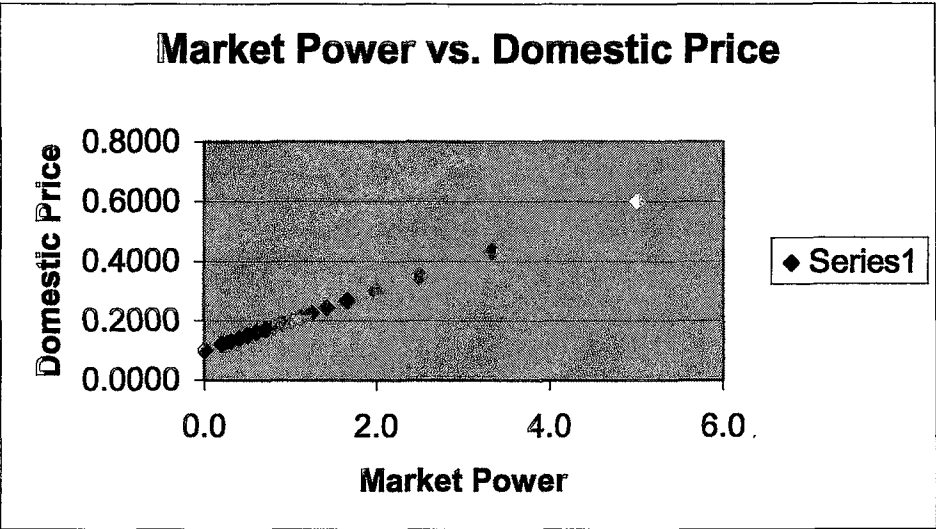
<sup>6</sup> Or any other weighted sum.

## 4.2. Calibration Analysis

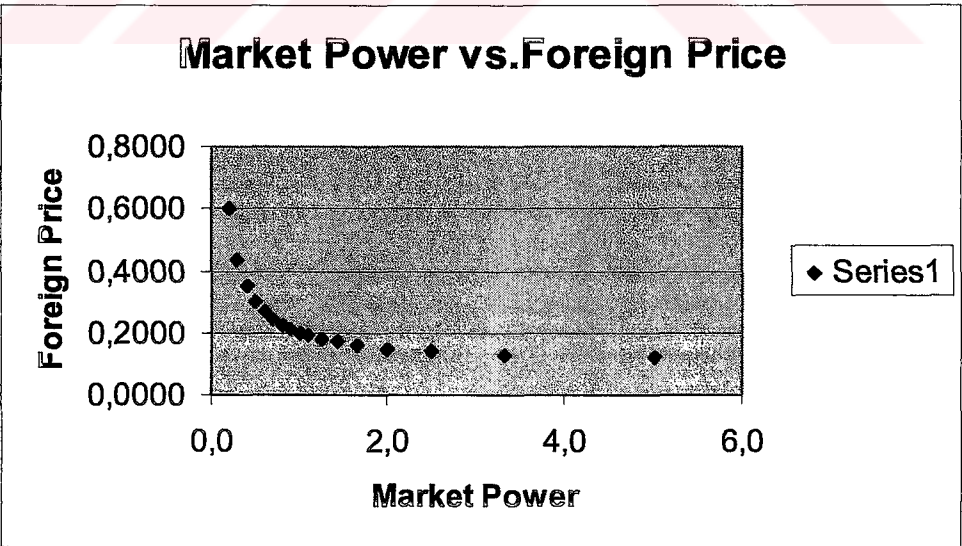
In the previous section we obtained closed-form solutions for the endogenous variables. Below illustrations will be helpful to exhibit the intuition behind mathematical solutions. I took  $\alpha, \phi, \psi, \psi_B$  values as 0,5. The income values for countries A and B are 10 and same. The market power in country B is 1. These values are chosen for simplicity and symmetry. Results are similar for different parameter values. They demonstrate the effect of market power on consumption and price levels in home and abroad. The data used for the calibration can be found in Table 1.



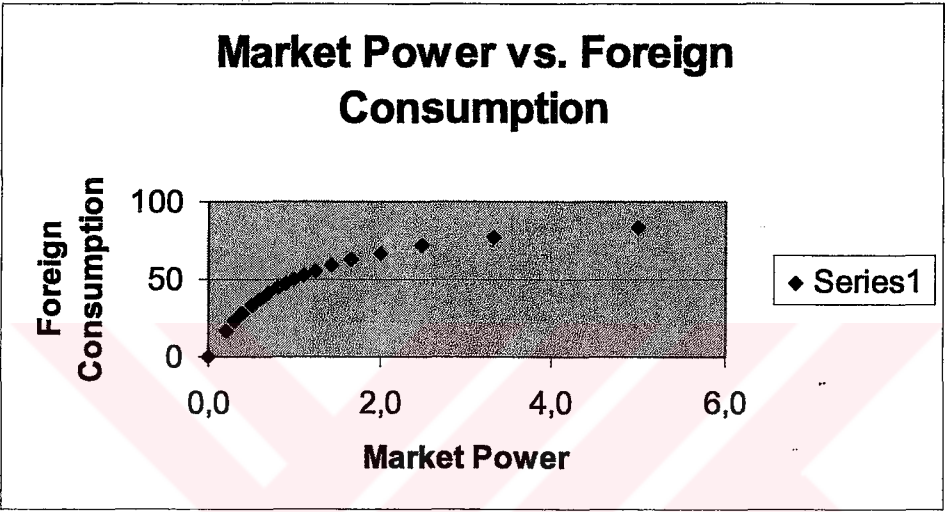
**Figure1:** Domestic consumption level as a percentage of production with respect to change in market power (Equation 16).



**Figure2:** Domestic price level with respect to change in market power  
(Equation 20)



**Figure 3:** Foreign market price of the product with respect to  
change in market power (Equation21)



**Figure 4:** Foreign market consumption level of the product as a percentage of total consumption with respect to market power (Equation 18).

## **CHAPTER 5**

### **CONCLUSION**

In this study, we investigate the behavior of export-import prices and their relative amounts. Deviations from purchasing power parity are empirical fact and it is hardly explained by usual frictions in international trade i.e. taxation and transportation costs. Our theoretical model relates the deviations from purchasing power parity with the characteristic of the market, which strengthens our approach to an equilibrium exchange rate. The recent analyses suggest that, with imperfect competition, firms may be able to charge a different price for their product on each specific market. In international media firms make destination specific adjustments in response to exchange rate changes, which is referred to in the literature as pricing-to-market. We have explained the rationality of this phenomenon in our theoretical model. In the case of open economies with flexible exchange rates, the analyses suggests that a combination of integrated world capital markets and geographically segmented goods markets will often produce instability in response to shocks originating in policy changes (i.e. Turkey's foreign trade imbalance after 2001 devaluation). Our theoretical analysis involves estimating the effects on exports and imports of a country when there is market power, price changes, and deviations from purchasing power parity.

As the market power increases in a country then a good's price will go up and consumption will go down in this country, however the same effect causes the price of the good to go down and consumption level to go up in the other country. Purchasing power parity holds when both markets are perfectly competitive or there is equal market power in both countries. Since obtaining equal market power for various goods is harder to observe, the condition of perfectly competitive markets will give a more general intuition. This study helps us to understand behavior of markets and firms to real shocks and change in the market structure. The economic interpretation of the fluctuations on prices and exchange rates has become clearer. Knetter (1993) implies that: "Future research should attempt to explain pricing to market on the basis of observable industry characteristics". We have filled some part of this gap and reasoned the deviations from purchasing power parity reality in a general equilibrium model and our market power definition has served as the observable industry characteristics. Determining the level of market power with its sources are the next topics on the agenda in this area of research. By using Herfindahl Hirschman Index (HHI) or Four Firm Concentration Ratio the market power can be represented quantitatively and further econometric studies can be performed. Hence this study opens a new gate in the exchange rate economics. Besides by the help of understanding market power among international markets we can examine economic importance of international trade policies among sectors. However, since competitors are changing rapidly, the tools used to measure departures from competition may not be economically significant and applicable.

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## APPENDIX A

Here I list the equations used to solve the model. The unknowns are:

Endogenous variables:  $e, p_1, p_1^B, p_2, p_2^B, c_1, c_1^B, c_2, c_2^B, \lambda, \lambda^B$

$$p_1^B = \frac{e \cdot p_1}{\Theta_1} = \frac{(1-\alpha) \cdot \Theta_1 + \alpha}{(1-\alpha) \cdot y \cdot \Theta_1} \quad \text{numeraire} \quad (30)$$

$$p_1 \cdot c_1 = \frac{\alpha}{1-\alpha} \cdot p_2 \cdot c_2 \quad \text{max\_c} \quad (31)$$

$$p_1^B \cdot c_1^B = \frac{\Phi}{1-\Phi} \cdot p_2^B \cdot c_2^B \quad \text{max\_c} \quad (32)$$

$$e = \frac{p_1^B}{p_1} \cdot \Theta_1 \quad \text{max\_f} \quad (33)$$

$$e = \frac{p_2^B}{p_2} \cdot \Theta_2 \quad \text{max\_f} \quad (34)$$

$$\begin{aligned} c_1 + c_1^B &= y \\ c_2 + c_2^B &= y^B \end{aligned} \quad \text{eq} \quad (35)$$

$$e = \frac{p_1^B \cdot c_1^B}{p_2 \cdot c_2} \quad \text{eq} \quad (36)$$

$$\lambda = \frac{u_1}{p_1} = \frac{u_2}{p_2} \quad \text{by 5\&6, max\_c} \quad (37)$$



APPENDIX B

|             |     |            |     |
|-------------|-----|------------|-----|
| $\alpha$    | 0,5 | y          | 10  |
| $1-\alpha$  | 0,5 | y_B        | 10  |
| $\varphi$   | 0,5 | $\Theta_1$ | *** |
| $1-\varphi$ | 0,5 | $\Theta_2$ | 1   |

Table 1:Parameter Values

| $\Theta_1$ | $c_1$ | $C_2$ | $c_{1B}$ | $c_{2B}$ | $p_1$    | $p_2$  | $p_{1B}$ | $p_{2B}$ | $\lambda$ | $u$    |
|------------|-------|-------|----------|----------|----------|--------|----------|----------|-----------|--------|
| 0,0        | 10    | 5     | 0        | 5        | 0,1000   | 0,2000 | ---      | 0,2000   | 1,3296    | 4,6469 |
| 0,0        | 10    | 5     | 0        | 5        | 0,1001   | 0,2000 | 100,1000 | 0,2000   | 1,3292    | 4,6462 |
| 0,2        | 8     | 5     | 2        | 5        | 0,1200   | 0,2000 | 0,6000   | 0,2000   | 1,2703    | 4,5267 |
| 0,3        | 8     | 5     | 2        | 5        | 0,1300   | 0,2000 | 0,4333   | 0,2000   | 1,2452    | 4,4764 |
| 0,4        | 7     | 5     | 3        | 5        | 0,1400   | 0,2000 | 0,3500   | 0,2000   | 1,2223    | 4,4311 |
| 0,5        | 7     | 5     | 3        | 5        | 0,1500   | 0,2000 | 0,3000   | 0,2000   | 1,2014    | 4,3900 |
| 0,6        | 6     | 5     | 4        | 5        | 0,1600   | 0,2000 | 0,2667   | 0,2000   | 1,1822    | 4,3525 |
| 0,7        | 6     | 5     | 4        | 5        | 0,1700   | 0,2000 | 0,2429   | 0,2000   | 1,1644    | 4,3181 |
| 0,8        | 6     | 5     | 4        | 5        | 0,1800   | 0,2000 | 0,2250   | 0,2000   | 1,1479    | 4,2863 |
| 0,9        | 5     | 5     | 5        | 5        | 0,1900   | 0,2000 | 0,2111   | 0,2000   | 1,1325    | 4,2569 |
| 1,0        | 5     | 5     | 5        | 5        | 0,2000   | 0,2000 | 0,2000   | 0,2000   | 1,1180    | 4,2295 |
| 1,1        | 5     | 5     | 5        | 5        | 0,2111   | 0,2000 | 0,1900   | 0,2000   | 1,1030    | 4,2012 |
| 1,3        | 4     | 5     | 6        | 5        | 0,2250   | 0,2000 | 0,1800   | 0,2000   | 1,0856    | 4,1686 |
| 1,4        | 4     | 5     | 6        | 5        | 0,2429   | 0,2000 | 0,1700   | 0,2000   | 1,0651    | 4,1305 |
| 1,7        | 4     | 5     | 6        | 5        | 0,2667   | 0,2000 | 0,1600   | 0,2000   | 1,0404    | 4,0854 |
| 2,0        | 3     | 5     | 7        | 5        | 0,3000   | 0,2000 | 0,1500   | 0,2000   | 1,0103    | 4,0308 |
| 2,5        | 3     | 5     | 7        | 5        | 0,3500   | 0,2000 | 0,1400   | 0,2000   | 0,9721    | 3,9630 |
| 3,3        | 2     | 5     | 8        | 5        | 0,4333   | 0,2000 | 0,1300   | 0,2000   | 0,9215    | 3,8757 |
| 5,0        | 2     | 5     | 8        | 5        | 0,6000   | 0,2000 | 0,1200   | 0,2000   | 0,8495    | 3,7561 |
| 1000,0     | 0     | 5     | 10       | 5        | 100,1000 | 0,2000 | 0,1001   | 0,2000   | 0,2364    | 3,0568 |

Table2:Calibration Results(Equilibrium Values as a Function of the Market Power)