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SECTORAL INTERACTION AND TRANSFORMATION OF A PREDOMINANTLY AGRARIAN ECONOMY: A DISCOURSE IN THE LIGHT OF THE CLASSICAL POLITICAL ECONOMY FRAMEWORKS

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Abstract

This article is concerned with the interactions between the agricultural and non-agricultural sectors of an economy as conceived in the classical political economy frameworks in the context of the process of economic development. It is argued that while Quesnay emphasizes agriculture in producing economic surplus and, in contrast, Adam Smith stresses industry, both of them have recognized the importance of interactions or inter-linkages between these two sectors in a growing economy. Agricultural growth strengthens domestic market and thus creates demand for manufactured goods and, in turn, the industrial class will spend more on agricultural produce (the Physiocrats). On the other hand, for higher growth through higher productivity as well as efficiency, industry would employ the strategy of division of labour through extensive subdivisions in the production system (Adam Smith). And this will lead to expansion in industrial employment opportunity for the labour abundant in the agricultural sector. The paper then discusses transformation of a predominantly agrarian economy in the light of the theories of Ricardo and Marx. The Ricardian system even helps us understand today's situation where industrial capital is entering into agriculture through contract farming and agro-processing business. The Marxian analysis saw the proletarianization of the peasantry with the rise of capitalism. According to Marx, destruction of rural domestic industry can provide the internal market which the capitalist mode of production requires.

JEL Classification: B12, Q10, O10, O20

Keywords: classical political economy; agriculture/non-agriculture interactions; economic development.

1. Introduction

This article is concerned with the interactions between the agricultural and non-agricultural sectors of an economy as conceived in the classical political economy frameworks in the context of the process of economic development.

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Such interactions received attention of the scholars right from the time of the 18th century France – i.e. from the writings of the Physiocratic School led by François Quesnay (Harriss, 1987; Bharadwaj, 1987). The Physiocrats (who were advocates of 'natural law' or laissez faire or self-regulating economic order that emerged to counter the domination of monopoly powers under mercantilism)[1] and Adam Smith strongly favoured agriculture and industry, respectively, in the pursuits of development policies, but, at the same time, they did not forget to endorse the need for sectoral linkages. In this regard, Ricardo's theoretical contribution of income distribution also seems to be very interesting. Especially, as regards today's development in agriculture sector such as contract farming, Ricardian one-sector model of income distribution is helpful in understanding the present context of the relationship between small landowning farmer and big capitalist (processor-investor) and the transfer of means (actually, rights) of agricultural production from the hands of farm owner to large capital owner. In this context, Marx elaborates the motives of capitalists. Capitalism does not need rural small producers; it just needs consumers. Creation of proletariats serves this purpose. But capital-intensive industry does not always follow Lewis (1954)[2] model and create large-scale employment opportunity for the rural masses, at least at the initial stage of growth. The rural sector needs proper attention – not only for the sake of rural sector alone but also for urban industrial growth.

The organisation of this article is as follows. Since this article is concerned with the interactions between the agricultural and non-agricultural sectors of the economy in the process of economic development, we discuss the views of the Physiocrats and Adam Smith in this regard in section 2. We discuss in section 3 the conflict between capitalist and landlord in the light of the income distribution theory of David Ricardo. Marx's views and the present development process are discussed in section 4. The article concludes with section 5.

2. The Physiocrats and Adam Smith: Agriculture/non-agriculture Linkages in the Context of Economic Progress

François Quesnay's famous Tableau économique summarised (re)production and associated theory of commodity circulation (i.e. distribution) from the perspective of an extensive agriculturally-led state, the population of which is divided into three socioeconomic classes (Johnson, 1966; Gide and Rist, 1915; Meek, 1962: 20): (1) the farming community (the productive class), (2) the proprietary class, and (3) the industrial class (the sterile class). The industrial/

artisan (manufacture) sector was believed not to produce any physical surplus (or net product) and hence called *sterile*. For further details about these three categories and a brief pertinent discussion, see Box 1.

To the Physiocrats, the agriculturists were seen to be the only productive class. Thus, being the only productive class in the society, the first class supplies the total flow of wealth in the economy. But the problem lies in the fact that class 1 needs non-agricultural products too for their work and life. Gide and Rist (1915) argue that Class 1 also requires manufactured goods, which it must get from the sterile class. On the other hand, money earned by the sterile class is employed in buying the necessaries of life and the raw material of industry.

However, in our context, the significance of Quesnay's theory is that there is *some linkage* between class 1 and class 3, i.e. between agriculture and manufacturing (although *sterile*). From the Physiocratic point of view, Meek (1962: 21-22) elaborates the linkage mechanisms further. If agricultural output rises from year to year, the general level of economic activity including industry will also increase. An increasing net product means, in the first place, that the landowners will spend more on both agricultural produce and manufactured goods, and the producers of these goods, whose purchasing powers are thus increased, will in their turn spend more on agricultural produce. An increasing net product means, in the second place, that more resources are available for investment. The landowners will invest more to improve their land; the agricultural entrepreneurs will have more to spare for maintaining and expanding their fixed and working capital; and thus aggregate investment in agriculture will increase, and once again output will be stimulated. In this way, cycle will continue to further growth. If agricultural output (and thus the net product) is decreasing from year to year, on the other hand, a reverse process will take place in the economy (including industry).

In contrary to Quesnay, Adam Smith stressed the importance of manufacturing sector by recognising the fact that industry also contributes to "net product." While talking about natural progress of wealth or opulence, Adam Smith divided the "course" into three different stages. The greater part of the capital of every growing society is, first, directed to agriculture, afterwards to manufactures, and last of all to foreign commerce. Therefore, the great similarity between Quesnay and Adam Smith is that both of them discussed the role of agriculture in the process of economic development. Adam Smith believed that agriculture had the potential to provide a vastly greater economic surplus than industry, but in his judgement the surplus industry offered was not zero (Eltis, 1988). Industry can be expected to provide enormous benefits to the

Box 1: Three Socioeconomic Classes in Quesnay's Framework

The three socioeconomic classes, as presented in Quesnay's Tableau économique, are as follows:

(1) The first class consists of agriculturists, including fishermen and miners. This class is the only productive class in the economy (Gide and Rist, 1915: 38).

(2) The second class is called proprietary class, which not only includes landed proprietors, but also those "who have the slightest title to sovereignty of any kind in the society. This class is seen as the bearers of the responsibility of survival of feudalism, where the two ideas of sovereignty and property are always linked together" (Gide and Rist, 1915: 38). This class belongs to the no-man's-land between the productive class and the sterile class i.e. industrial class, sharing to some extent the character of each but belonging definitely to neither. This class consisted of the landowners, the king, and the clergy, who were assumed to receive, in the form of rent, taxes, and tithes respectively, the value of the net product which agriculture annually yielded (Meek, 1962: 20).

(3) The third is a sterile class, consisting of merchants/distributors, manufacturers (self-employed artisans and craftsmen), professionals, and domestic servants (Gide and Rist, 1915: 38).
The most prominent part of this model is that manufacturers are recognised as suppliers of non-food items that are needed by the agriculturists, on the one hand, but are *ignored* as a productive class, on the other. Eltis (1988) helped us understand this well. Quesnay's conclusion, which not only astonished his subsequent generations of economists but also his contemporaries, was actually driven by a belief that industry as constituted in France in the seventeenth and eighteenth centuries could not make any net contribution to tax revenues of the nation. Its "net product" (produit net), or taxable capacity, or economic surplus, was zero, and thus it could not make any contribution to the military and welfare needs of the state. When criticism came up from the fact that manufacturing and commercial states like Venice and Holland had accumulated wealth and power, Quesnay insisted that taxable industrial and commercial profits had been seen only where businesses had managed to achieve elements of monopoly power. Eltis (1988) noted that this had arisen in Quesnay's Europe in several ways. States frequently provided political supporters with monopoly privileges, or they sold future monopoly rights for current cash, or they allowed corporations with monopoly power to emerge and thus protected their own countries' industries. And, this had prompted the Physiocrats to argue for laissez faire.

whole economy through the productivity enhancements associated with the division of labour. The important difference between Smith and Quesnay is that Smith believed industrial profits could include an element of economic "surplus" in the sense that industrial capitalists can save and invest from their profits, with the result that they have the potential to add to the growth of the economy. Smith's main objection to Quesnay's argument is that it has neglected the enormous advantages a society can obtain from the division of labour which can be applied in industry than in agriculture. The division of labour in industry leads to more extensive subdivisions of as well as expansion in industrial employment, and hence to the achievement of higher productivity through the invention of superior machinery. Smith (1776) argues that a country which successfully develops its industry can attain far more favourable terms of trade between agricultural produce and manufactures than one which could not substantially develop its industrial sector. Although it is clear from these arguments that Smith stressed more on industry than agriculture, he did not forget to emphasise the role of interlinkage between agriculture and industry during the course of take-off or economic development. According to him, the great commerce of every civilised society is carried on between the inhabitants of the town and those of the country. "The country supplies the town with the means of subsistence and the materials of manufacture. The town repays this supply by sending back a part of the manufactured produce to the inhabitants of the country" (Smith, 1776: 479). Let us now conclude this section with the observation of Meek (1951) who argued that no one could deny that agriculture was historically prior to industry and commerce, and that, at least in the absence of international trade, the size of the agricultural surplus did still effectively influence the extension of industry and commerce. It is primarily agricultural growth which smoothens and broadens the path of industrialisation and international trade for the poor but agriculturally endowed regions. In a dynamic process of growth (at least at the initial stage), inter-linkages between primary and non-primary sectors become crucial with advancement. As regards contemporary problems, we discuss later in brief why careful attention should be paid to farm sector during the sectoral transformation process in densely populated agrarian economies. Now, we explain, with the help of Ricardo, that if something goes wrong with the farm sector, the overall economy may suffer; and, therefore, the present transformation in the farm sector (e.g. introduction of big capital in agriculture through contract farming) should be dealt with carefully, keeping in view the interest of the local small farmers, decrease in whose real income may shrink the domestic market for industrial products including those produced by rural small producers.

3. David Ricardo, the Conflict between Capitalist and Landlord, and a Modern Treatment

Ricardo's theory of distribution had three elements – a theory of rent, a theory to explain wages and a theory of profits. National income, according to his theory, was divided into these three categories and he showed what happened to rents, wages, and profits over time as economies grew (Pressman, 1999). Agriculture had been at the centre of his theory of distribution and considered to be the determinant of general profits in the economy. Hence, while talking of Ricardo's theory of profit, Dobb (1973) termed it as Corn Theory of Profit. Dobb elaborates that there cannot be two different profit rates in manufacture and agriculture consistently, since there is a general tendency towards a uniform profit-rate in the economy. If agriculture received higher profits, more capital would enter agriculture and push down prices and profits (Pressman, 1999) and the impact of such adaptation must fall on the prices of manufactures, until as a result of these price-movements the same rate of profit was being achieved in manufactures as in agriculture (Dobb, 1973). The only way in which the rate of profit in agriculture could be altered was by a shift in the margin of cultivation.

3.1 Malthus's Criticism and Ricardo's Modification

In his correspondence with Ricardo sometime during 1814-15, Malthus criticised the arguments regarding general profits, saying that an expansion of trade, especially of foreign trade, could raise the general rate of profit (Dobb, 1973; Hollander, 1973). For example, general profit could be affected by high prices of manufactures due to a strong demand for them, such as flourishing export-demand. In that case, how could it shift agricultural profits by shifting the margin (see Dobb 1973)? Actually, Ricardo's assumption was that wages were given in terms of corn, i.e. the subsistence of the labour employed, and hence corn-wages were independently given as determined by the subsistence level. So, agricultural labourers did hardly have any ability to create demand for manufactures after meeting their subsistence. In such system, the demand for corn at any given date is determined by the size of the labouring population (implying a fairly inelastic demand for necessaries). But the intervention of foreign demand for manufactures, as introduced by Malthus, disturbed the theory of agriculture-determined general profit as conceptualised by Ricardo. In respect of Malthus's arguments, Ricardo later modified somewhat his earlier view that agricultural profits determine general profits absolutely. He did so

by allowing for the fact that the labourers did not only consume corn, but also consumed some manufactured goods. In spite of this, however, he eventually maintained his main position that general profits could not deviate from the ratio of corn produced to the corn-wages involved in its production at the agricultural margin. In Edelberg's (1933: 58) interpretation, "...the surplus product of the one-year investment over the wages bill invested for one year is the profit of the capitalist farmer for one year." Let us now see when the interests of the capitalist farmer and landlord clash.

3.2 Conflict between Capitalist and Landlord in a Growing Economy

Next, what is very interesting in the light of the Ricardian theories is the conflict between capitalist and landlord. Of his theories of rent, wages, and profit, Ricardo had fitted together the theory of profit with the theory of rent and concluded that rent and profit were found to be antagonistic in the sense that increase in rent would cause decrease in profit and represent a mere transfer of net revenue. The ideal situation is as follows. If a country grows in wealth and population, more food has to be produced to feed the increased population and that could be done by adding new portions of fertile land along with every increase of capital and, thus, such increase would not allow profits to fall and rents to rise. But fertile land remained limited. Therefore, as cultivation was extended, profits tended to fall as a result of diminishing productivity of labour at the margin (see Dobb 1973). Moreover, there could be a possibility of bringing less fertile land into use.[3] The whole situation would increase the rents (since demand for fertile land would increase), thus transferring the profits of the farmer into the pockets of the landowner (see also Barkai, 1959). In Ricardo's view, the interest of the landlord was always opposed to the interest of every other class (i.e. capitalist farmer/entrepreneur and labourer) in the community. As profits fall, the motivation for accumulating capital disappears and economic growth takes downward trend. To correct the situation, Ricardo prescribed that a repeal of high import duties on corn, to allow entry of low-priced foreign corn, and thus to reduce the amount of domestic land for growing food, would raise profit and thereby promote capital accumulation. However, let us now see the above conflict in the current context.

3.3 Ricardo and a Modern Treatment of the Conflict

Ricardo's theory of distribution has some implication in the present agrarian scenario of the developing countries. Through the initiation of contract

farming, a (major) share of profit now goes to the capitalist/agro-processor's pocket. The linkages between farm and agro-processing industries might have opened up a new growth path in the rural economy, but there is a clear tendency of shifting of control of production from the farmers to the processing sector. In Ricardian framework, landlords had been expected to benefit from overall economic growth (since rent was expected to rise), whereas in the present situation the agro-processing (large) industrialists have been tending to hold the key position in the agricultural sector, especially in the countries such as India where small and marginal farmers who have very low investment capacity constitute a very large proportion of the farming community (of about roughly 100 million holdings in India, more than 80 million have less than one hectare of land).[4] But we need to keep in mind that in Ricardian framework the investors, not the landlords, had been considered to be farmers. Landlords only enjoyed the rents whereas investors were considered to be capital accumulators or surplus generators. Similarly, in the present contract farming system, the investors are considered to be capital accumulator, but, in contrast, they are not considered farmers; rather landlords are considered farmers.

In the Ricardian system, we find that landlords are considered to be idle partners who do not play any entrepreneurial role in the production process and consequently do not bear risks. But, under contract farming, it is just the opposite. It is the landowner who remains involved in the crop production and bear immense risks and, however, it is needless to say that the situation needs to be corrected through institutional measures. Where is the risk for farmer-cum-landowner under the contract farming system? Citing the case of gherkin production contracts in Karnataka, India, Singh and Asokan (2005) observed that "there were certain clauses in the contract which seemed to favour the processor…. If the crop failed due to any natural calamity or due to pest and diseases, the entire loss is borne by the farmer" (p. 90).

The small landowners do not only provide their lands but also provide their family labour, wages for which are included in the gross return. At this point, Sraffa's addition helps us in capturing the situation well. Following Ricardo's concept, Sraffa established an inverse relationship between the rate of profits and the share of wages (Kurz, 2012: 32). Thus, an increase in wage rate would result in decrease in the rate of profit. How to solve this problem from the point of view of a capitalist? Here, the crux of the matter is: Once the problems of wage and rent are solved (as the farmer's family provides both labour and land), profits are defined as residual magnitude (Roncaglia, 1983). Thus, if the landowning farmer bears most of the risks or all the risks through a contract in the investor's term and his whole family (including him) renders

the daily labour, then both the rent (as indicated, rent in this case is not fixed but proportional to the loss, if any, incurred by the processor) and wage are settled. And, consequently, the processor-investor is faced with very minimum risk. This sort of proletarianisation of small landowners (we would discuss this again in the context of Marx) would have adverse impacts on income distribution, savings formation and, consequently, multiplier effects. Farmer's uncertainty involved in the contract needs to be removed. Pasinetti (1962) argues that if workers (in this specific case, contract-bound small landholders) earn a living equitable to their subsistence, or if they are deprived of their entitlements, they are unable to save and thus they do not contribute to the stock of capital (which further entitles the owner to a rate of interest) which exists in the system. This means that the new system (i.e. contract farming) may not bring about any changes at the lower strata of the farming community and thereby the process of development in an agrarian economy may not witness an optimistic outcome unless the interests of the small farmers are protected through proper intervention.

Ricardo's landowners had been considered to be of very low importance in the process of economic growth due to their passive role in capital accumulation and in generating multiplier effects in the growth process; but our landowners, the majority of whom are small and marginal (Khan, 2004), are actively involved in production. Their clubbing with the processors-investors has likelihood to generate multiplier effects in the non-farm economy of the developing countries. But the state needs to come up with protective legislation in favour of farmers so that they are not exploited by the takers of their produces; they do not lose total control over production; and they do not face total ruin if bad harvest occurs as a result of natural calamity or so.

4. Karl Marx: Farmland Acquisition for Industry and Destruction of Rural Domestic Industry under Capitalistic Mode of Production

In dealing with the process of capitalist development, Karl Marx believed that the capitalist relations would ultimately engulf agriculture as well as rural industry with a concentration of property in land, the proletarianisation of peasants, large productivity gains of capitalist agriculture, displacement of working capital and labour previously engaged in small-holdings and artisan manufactures.

Marx (1954)[5] viewed the capitalistic system of production as the destructive force of rural domestic industry. We quote him from *Capital (Vol. 1)*: "Formerly divided among a number of small producers, who cultivated it

themselves and with their families spun it in retail fashion, it is now concentrated in the hand of one capitalist, who sets others to spin and weave it for him" (Marx, 1954: 698). Hence, the process started supplying wage-labour to industry. He added:

Formerly, the peasant family produced the means of subsistence and the raw materials, which they themselves, for the most part, consumed. These raw materials and means of subsistence have now become commodities; the large farmer sells them, he finds his market in manufacturers. Yarn, linen, coarse woolen stuffs – things whose raw materials had been within the reach of every peasant family, had been spun and woven by it for its own use – were now transformed into articles of manufacture, to which the country districts at once served for markets. The many scattered customers, whom stray artisans until now had found in the numerous small producers working on their own account, concentrate themselves now into one great market provided for by industrial capital. Thus hand in hand with the expropriation of the self-supporting peasants, with their separation from their means of production, goes the destruction of rural domestic industry, the process of separation between manufacture and agriculture. And only the destruction of rural domestic industry can give the internal market of a country that extension and consistence which the capitalist mode of production requires (pp. 699-700).

The thinning-out of the independent, self-supporting peasants brought about an increase in the number of industrial proletariat in the urban sector. In spite of the smaller number of the cultivators, agricultural production was not supposed to decrease because the revolution in the conditions of landed property was accompanied by improved methods of cultivation, greater co-operation, and concentration of means of production. The ruin of the peasantry as well as the rural domestic industry was a vital condition for capitalist development. The critics of this view opined that such destruction would decrease purchasing power of people and narrow the domestic market and thus would impede capitalist development. Vygodsky (1966: 21) elaborated the Marxian view: "The emergence of capitalist production would be inconceivable without creation of an army of workers, deprived of the means of production. This, in fact, was the real sense and economic reason of the mass expropriation, carried out with unprecedented cruelty." With the setting free of a part of the agricultural population, therefore, their former means of nourishment were also set free. Lenin, as cited in Vygodsky (1966: 22), added that capitalism needs the free labourer. The impoverished peasant who formerly lived by his own farming

now lives by selling his labour power. He now has to purchase essential things of consumption. On the other hand, the means of production from which this peasant is freed are concentrated in the hands of a minority and are converted into capital. The expropriated peasants are bound to buy their value in the form of wages from his new master (i.e. the industrial capitalist). Thus, formation of glut of agricultural produce is not possible. "That which holds good of the means of subsistence holds with the raw materials of industry dependent upon home agriculture" (Marx, 1954: 697-698).

Actually, at the centre of this discussion lies the question of livelihood of poor rural population, mainly the small and marginal farmers who constitute a significantly large section of the farming community in a developing country such as India. Perhaps, in the context of present day, the question of livelihood would not have arisen, if the large industry sector had been able to provide employment to the large number of rural unskilled poor. It is difficult to think that modern technology-based industry would absorb a large unskilled rural mass. In the last one decade, forcible land acquisition by several governments (on behalf of the big industrialists) has drawn attention of many people, including scholars. Let us now very briefly discuss this before we conclude.

Theoretically, when does growth of industry fail to provide full employment to large masses? In this regard, John Barton[6] argued that the demand for labour depends on the increase in variable capital (since a part of it is used for hiring labour), not on fixed capital. As civilisation is extended through inventions and innovations, fixed capital bears a larger and larger proportion to variable capital. In this context, Marx (1954) argued that a relative surplus population is found in a country or region when increase of labouring population moves more rapidly than that of variable capital or the means of employment. Hence, the issue of livelihood of such surplus population inevitably arises and a programme of addressing the issue must be formulated as well as implemented along with forcible land acquisition agenda.

5. Conclusion

This paper has sought to revisit the discussions on interaction between agriculture and non-agriculture and the process of transformation of a predominantly agrarian economy in the light of the classical political economy frameworks, as portrayed by the Physiocrats, Adam Smith, Ricardo and Marx, especially when rapid structural transformation in rural economy of many developing countries has been taking place through penetration of large industrial capital into agriculture (in other words, through contract farming and

organised retailing) and, of course, through intrusion of fertile agricultural land by new large industrial projects and realtors.

While Quesnay considered industry to be sterile sector (due to its inability to produce net product), it was the fact that agriculturists were also dependent on manufactured goods for the upkeep of their daily life. On the other hand, although Adam Smith emphasises industry for its scope of increasing productivity through extensive division of labour, he observes that while a part of the labour force is engaged in producing food the other part is engaged in manufacturing activities, and, thus, indicates an economic interaction between agriculture and industry. With large investors entering into agriculture through contract farming, Ricardo's one-sector income distribution model helps us gain new insights from the present rural economic system. Karl Marx viewed the capitalistic system of production as the destructive force of rural domestic industry. Through creation of new proletariats, capitalism tends to expand the market. While large-scale industrialisation is important for regional growth and employment of skilled labour, the large industry prefers to invest more and more fixed capital than variable capital (i.e. the means of employment), and thus the scope for employment of unskilled or semi-skilled labour tends to shrink. Therefore, in a labour-abundant economy, agriculture and (rural) small enterprises assume special significance from the perspective of livelihood and employment. That is, agriculture and rural non-farm activities would continue to occupy a very important position in a predominantly agrarian economy until the process of large-scale industrialisation becomes grossly successful in mitigating rural unemployment problem in the developing economies.

Notes

1. Mercantilists emphasised the importance of trade and money, whereas the Physiocrats "looked behind money to goods and deemed them true wealth" (Johnson, 1966: 616). However, according to Gide and Rist (1915: 36), "[t]he Mercantilists thought that the only way to increase wealth was to exploit neighbours and colonists, but they failed to see that commerce and agriculture afforded equally satisfactory methods."

2. which was later extended by Ranis and Fei (1961).

3. Fellner (1960: 70) explains that the number of farms rises as agricultural output expands. "Gradually farms must become located on increasingly less fertile lands, and hence they must operate at increasingly higher costs. This is the process of pushing the *extensive* margin further out to" the next land available.

4. See, for example, Khan (2004).

5. This edition of the *Das Capital* was published in 1954 by Progress Publishers, Moscow.

6. Cited in Marx (1954) as follows: Barton, John (1817), *Observations on the Circumstances which Influence the Condition of the Labouring Classes of Society*, London.

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A COMPARATIVE STUDY ON TOURISM DEMAND IN REGION WESTERN GREECE AND ITS CONTIGUOUS REGIONS

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Abstract

In this work, a comparative study, based on tourism behavior of Western Greece region and its contiguous areas, is investigated. In particular, the inherent seasonality, as well as the future of tourism demand of region of Western Greece is explored, in comparison with its adjacent regions, which are the region of Epirus, Ionian Islands, Peloponnese and Central Greece. The study of seasonality utilizes the concentration ratio, while the forecasting models of each region are constructed using the well-known ARIMA models. The development of these models is based on a mechanistic methodology and the goodness of fit of the proposed models is confirmed using some appropriate statistical tests. The models are evaluated using a data set collected over a period of 8 years (2005-2012), describing overnight stays of the hotels of the corresponding regions. The main objective of the presented comparison is to study the region of Western Greece along with each of its contiguous regions, in respect of seasonality and future trend.

JEL Classification: C22, C53

Keywords: Western Greece tourism, contiguous regions, overnight stays, tourism demand forecasting, forecasting model, time-series.

1. Introduction

Tourism can be described as a complex and dynamic system where random incidents can affect seriously its production or/and its consumption. Even for the non-experts in tourism industry, is evident that factors like natural disasters,

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cultural events, social behaviors, marketing policies etc., can influence the tourism flow in an area, sometimes in a positive, sometimes in a negative way.

The tourism industry in Greece is a vital part of national economy, since it is constituted of some important financial activities. Moreover, these tourism activities consist in a significant and valuable source of earnings, along with tourism employment, contribution in gross domestic product and multiplier effect investments. However, the measurement of the quantity and quality of the offered tourism products is a necessary step for the evaluation of all above activities for making reliable and robust tourism policies and directives.

One of the tourism descriptors is the overnight stays throughout the hotels of an area. Overnight stays can give us the necessary information to evaluate the hosted visitors and possibly the money spent during their staying. Therefore, a desirable task is to forecast monthly and/or annually percentages of overnight stays in Hotel units of Greece and in its various regions. Potentially, this task will give us the opportunity to use effectively (allocation) all the available sources for the Greece visitors.

Furthermore, the current global and local financial crisis reveals the decisive role of tourism in Greek economy. Actually, Greek tourism maintained its strength, despite the financial and social results of the local and global crisis and shows that with an effective support, the sector can become a leading force for producing more income for the country and improve the economy competitiveness worldwide. This dynamic of tourism in Greece, motivated mainly by the perspective of gaining high travel receipts fast enough, fascinated the local communities and groups of owners of capital to pursue and encourage tourism. Tourism, also, is an important source of income for many Greek regions, and especially for those with less developed modern service/industrial based economies, such as the Region of Western Greece.

All the aforementioned facts are crucial for all specialists and consultants who make decisions concerning tourism, in order to see clearly the near and distant future. Thus, it is considerably important to have the ability for accurately forecasting tourism demand, aiming in maximizing the benefits of selling the tourism product and minimizing possible losses from a predictable disaster or misadventure. But, because of the special nature of tourism product forecasters are not able to make, easily, reliable and efficient proposals for a future timeframe, especially for local areas, like region of Western Greece, where the information is not enough for describing adequately the area. In this direction, Panagopoulos An. & Al., trying to fill the information gap about the tourist identity of the region of Western Greece, proposed a forecasting model for predicting the tourist occupancy using the Box-Jenkins Method (Box &

Jenkins, 1976) using monthly data from January 1990 to December 1999 forecasting for two years (Panagopoulos An. & Al., 2005).

Since then, the study of the West Greece region still remains a great challenge. Any suggestions in the direction of modeling the overall tourist product circulation remain a well-timed issue for both researchers and local authorities.

The forecasting of tourism demand at regional level, but also, at the contiguous regions of Region of Western Greece, will give us, firstly, a clear picture of the development of tourism in the whole region and, secondly, the possibility of continuously updating the tourism data frame describing the future of tourism demand (especially hotel demand) regarding the tourism type and intensity. Any attempt for policy making and tourism development, in public and private sector, should be built on a reliable depiction of the trends and patterns (such as seasonality) of hotel demand at different spatio-temporal scales. The continuous quantitative and qualitative expansion of such data would allow the formulation of monitoring mechanism that will follow up the progress and evolution of tourism demand and consumption, and thus will play a key role in creating an integrated system of planning tourism development at regional and local level.

Forecasting, according to the literature is the prediction of the behavior of some future events (e.g. Makridakis & Hibon, 1979; Frees, 1996; Franses, 2004) and, therefore, plays an essential role in tourism planning. Thus, tourism investments should be organized and manipulated using professional business planning and an achievement vision of the industry future. It is clear, that the tourism industry needs to reduce the risks of poor decisions. One prompt way to reduce this risk is by discerning future events or environments more clearly (Smith, 1995; Burger et al, 2001). Anyone can see the resulting effect of the future prediction; in the case of forecasts of demands turning out too high, accommodation firms will suffer; there might be, for instance empty rooms in hotels, unoccupied apartments, and so on. If, on the other hand, the case turned out to be that forecasts of demand are too low, then firms will lose opportunities; for example, there may be inadequate hotel accommodation etc. (Chu, 2004). In practice, time series forecasts are extrapolations in future times of the available time series values. A good projection should provide a forecaster with a sense of the reliability of the forecast. A convenient way to capture this sense is the prediction interval, which provides a measure of the reliability of the forecast (Psillakis, Panagopoulos, & Kanellopoulos, 2009). An exhaustive review on forecasting time series can be found in (Song, & Li, 2008).

Another important factor in making tourism directives is the issue of seasonality. Seasonality, as an inherent characteristic of tourism demand, is the

tendency of tourist flows to become concentrated into relatively short periods of the year (Allcock 1994). Unfortunately, despite the clear appearance as a phenomenon, is often seen as a problem in terms of either tourist attraction (especially for those areas that rely on the beach and sun), or forecasting the future since it is an issue that have to be taking into account in order to produce reliable forecasting. Therefore, seasonality should be investigated and its nature should be clarified to form appropriate tourism policies and strategies.

So, in this work, the issue of forecasting the tourism demand is addressed and will be studied in respect of constructing prediction models and measuring the tourism concentration, while the presented study will be centered on the region of Western Greece and in comparison with regions of: Peloponnese, Ionian Islands, Epirus and Central Greece. In particular, ARIMA models will be developed for the studied regions working on overnight stays for the period 2005-2012 and a prediction for a 12-month horizon will be presented. The choice of an ARIMA model consists mostly in its flexibility and generality as it can handle different types of data. In addition, the seasonality of all regions will be studied employing a simple concentration ratio, focused on different seasons on a year revealing the potentiality or not of each region to increase the tourism share over different time periods.

The structure of the paper is as follows: In the next section a short profile of Western Greece, as well as a corresponding short profile of its contiguous regions are presented. Then, in Section 2 a simple seasonality analysis is realized and then some forecasting models for each of the studied regions are developed. Finally, in the last section some conclusions and remarks are discussed.

2. Regions' Description

2.1 Region of Western Greece

The basic reason for selecting the Region of Western Greece is the inherent dissimilarities of the prefectures of the Region, the different type of visiting tourists, the available resources and infrastructures and the level of development and employment. The region of Western Greece consists of three prefectures: the prefectures of Achaia, Etoloakarnania and Ilia. The land in these areas is mostly mountainous but with extensive coastline at all prefectures. The main economic activities in the region are agriculture and tourism services, with significant wine and olive oil production. The region accommodates

many, various and significant sensitive ecosystems. Finally, the region has significant tourism infrastructures which include 2 airports and 6 ports.

2.3 Region of Central Greece

The region of Central Greece consists of the prefectures of Evritania, Fokida, Fthiotida, Viotia and Euboea. The economic life in the Region of Central Greece includes activities mostly in agriculture, farming and tourism services. The region of Central Greece has, also, become a manufacturing hotspot due to the development of industrial zones in the southern Viotia, which is bordering with Athens. The manufacturing activities have generated economic spillovers but also important environmental problems (generally near the national transport networks), especially for water and soil resources. Due to its inherent geomorphology, the region of Central Greece region can be characterized for the great variety of climate, which is dry and mountainous in land and mild on the coasts.

2.4 Region of Epirus

The Epirus region covers the 6.97% of the total area of the country and includes the prefectures of Thesprotia, Ioannina, Arta and Preveza. The rugged terrains of the region provide only few natural resources and few agriculture products. One of the important activities in the region is the sheep and goat pastoralism (Epirus provides more than 45% of meat to the Greek market), but with decrement trend over the last years. Tobacco, farming and fishing are some of source of employment, but most of the area's food must be imported. Epirus is famous for its dairy products' brands and offers important tourism services, especially in eco-tourism. The outstanding natural beauty of the area, as well as its picturesque villages and traditional lifestyle, has made Epirus a strong tourist attraction.

2.5 Region of Ionian Islands

The region of Ionian Islands is a Greek cluster of islands at the west coast of Greece, lying from the Albanian coast to the southern tip of the Peloponnese and includes the prefectures of Corfu, Kefalonia, Ithaca, Lefkada and Zakynthos. Their total land area is 2,307 square km. Due to the significant rainfalls and the farmable lands, the Ionian Islands produce timber, fruit, and flax and raise pigs, sheep, and goats. Furthermore, they export currants, wine, cotton,

salt, olives, and fish, and the islands are largely self-sufficient in grains. They have, also, modern harbor infrastructure which encourage the international shipping.

2.6 Region of Peloponnese

The Peloponnese region covers the 11.74% of the total area of the country and includes the prefectures of Arkadia, Argolida, Korinthia, Lakonia and Messinia. On the west it is surrounded by the Ionian Sea and bordered by the Region of Western Greece. The economic profile of the Region includes mostly agriculture products and tourism services. Main agricultural products are fruits, olive oil and potatoes. The Peloponnese is also famous for its wine producing areas such as Nemea and Mandinea, as well as the cultural and natural sites. The last years a small industrial activity has been emerged. Peloponnese has a characteristic and unique morphology with big mountains occupying a part of the north, and the entire southeastern part of the western part of the whole of the Peloponnese.

The following Table 1 describes in short the geomorphic and economic status of the above described regions.

Table 1: Sort description of region of Western Greece and its contiguous regions

	Western Greece	Epirus	Central Greece	Ionian Islands	Peloponnese
Area (km^2)	11350,18	9203,22	15549,31	2306,94	15489,96
Population	679796	336856	547390	207855	577903
Density	59,89/km^2	36,6/km^2	35,2/km^2	90,1/km^2	37,31/km^2
GDP per capita	13.431,00 €	12.207,00 €	15.075,00 €	16.100,00 €	13.870,00 €

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3. Measuring seasonality

In economics, the concentration indices are used widely as the main analysis tool of degree of concentration of producers or salesmen in a specific commercial branch. These indices can be, also, useful in analyzing the seasonality of tourism demand. This means, that since the measurement of tourism

demand is possible, we are able to make comparisons of the seasonality of tourism demand in different time instances or between different areas.

The most common and simplest concentration index is the index of concentration ratio (CR). The CR index shows the share of the studied components of tourism demand in respect of their total value, in a specific time period. In this work, the examined component of tourism demand is described by the overnight stays and the considered time period is a calendar year. Thus, the CR index can be defined using the following formula:

$$CR_m = \sum_{i=1}^{m} S_i , \quad (1)$$

where, here, m denotes the number of studied months in respect of their share over one year and S_i is the share of the i month, defined as

$$S_i = \frac{Os_i}{Os} , \quad (2)$$

where OS_i is the overnight stays of the i month and OS the total overnight stays at the whole year.

In this work we want to compare the seasonality of all the above described regions over the summer months, which are, traditionally, the months with the most visitors during a year. For this reason, we evaluate the CR_4 index and it is applied on the months June to September, for all aforementioned regions. It is clear, from Figure 1, the seasonality disclosed from the CR_4 index. Especially for the Region of Ionian Islands, where the CR_4 index shows that during the summer months the total number of overnight stays exceeds the 79% of the

Figure 1: June to September seasonality

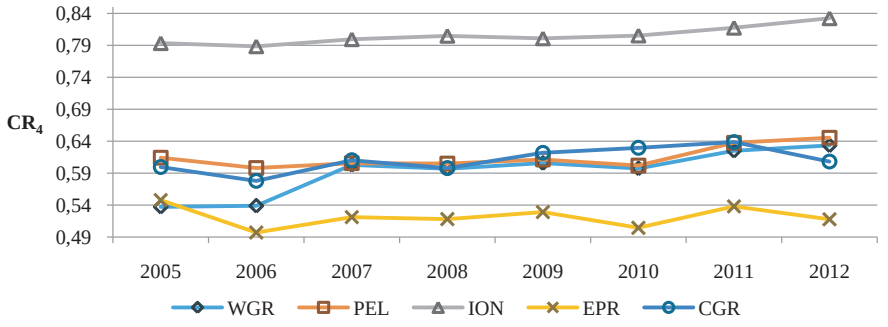
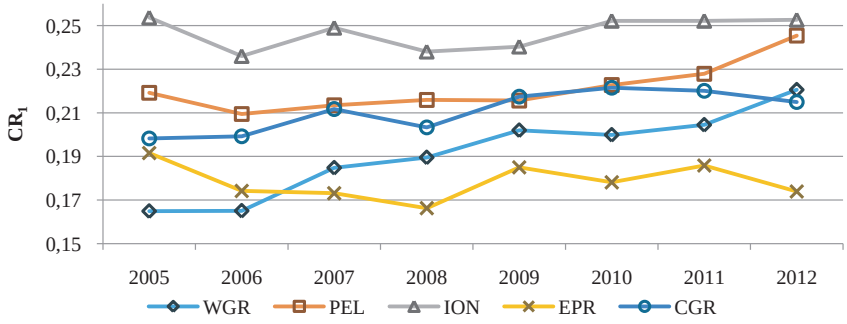


Figure 2: August's seasonality



total annual overnight stays, a strong seasonality for the 4 summer months is revealed. The rest of the regions have a smaller share on the total annual overnight stays, however they keep a significant percentage of the total annual overnight stays. Even though this is an expected result, a further study on seasonality in these regions for other time periods should be initiated. In particular, one may ask about:

- What is the actual share of August on the total overnight stays?
- How some annual events like Christmas and New Year's Eve or the Easter and Carnival affect the tourism demand?

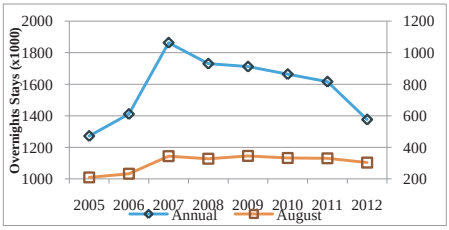
3.1 The significance of August

The month August, the heart of summer, drive travelers in every part of Greece, whether these are Greek or foreign visitors. During the August, due to their summer vacation, usually, people design and implement a trip to a destination. Thus, it is reasonable the observation an increment in overnight stays, almost anywhere, compared to the other months of the year. Therefore, in order to study the overnight stays concentration in August we introduce the CR_1 index, and it is applied on each of the studied regions, as it is showing in the next Figure 2.

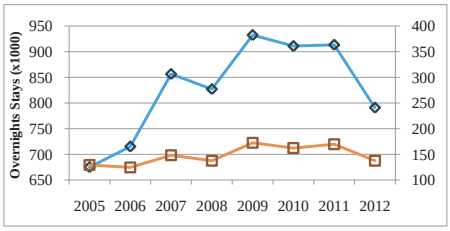
As a general comment on Figure 2, we can say that the August retains a significant share of the annual overnight stays through the period 2005-2012. Even for the worst case, the CR_1 is estimated more than 0.16 (if it is considered that all months are equal competitors then the CR_1 index will be 0,083).

At the same time if someone compares the concentration index CR_1,

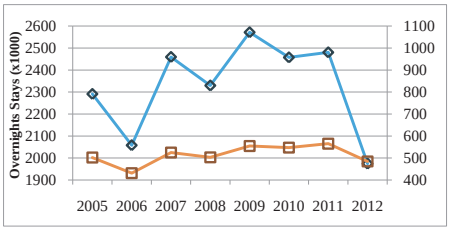
Figure 3: Annual (diamond-left) and August (square-right) overnight stays



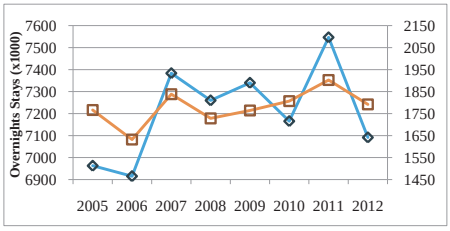
a. Western Greece



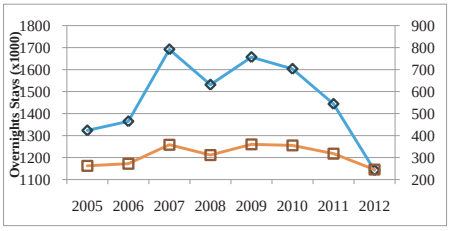
b. Epirus



c. Peloponnese



d. Ionian Islands



e. Central Greece

regarding the August (Figure 2), with the number of overnight stays both in August and annual ones (Figure 3), we can see that:

- Region of Western Greece: Despite the increasing trend on the concentration of overnight stays in August (Figure 2), there is an actual decreasing trend in the number of overnight stays in August (last 4 years), as well as in the total number of annual overnight stays (Figure 3a).
- Region of Peloponnese: For the last 7 years a clear raise in concentration is emerged. As it shown in the following Figure 3b we can see a small increment in the number of overnight stays until 2011, while in the last

year a significant loss in August (14,28%) as well as a significant loss in the annual number of overnight stays (20,4%), revealing an emerging seasonality in the region (Figure 3c).

- Region of Ionian Islands: The seasonality index tends to be stabilized and despite the intense fluctuations in annual number of overnight stays the number of overnight stays in August keeps an upward trend (Figure 3d).
- Region of Epirus: The concentration of overnight stays seemed to be fluctuated between 17% and 19%, indicating a moderate seasonality (Figure 3b).
- Region of Central Greece: Similar to Western Greece (Figure 3e), an increasing trend on the concentration of overnight stays in August is appeared, but at the same time the last 4 years of the observed data a significant reduction is disclosed (31,04% annually and 18,26% in August).

It is shown from the above figures that the start of crisis, back at 2008, reflected on the annual, as well as the August's number of overnight stays. Even if they manage to support tourism in August, however it seems, that aside the region of Ionian Islands the rest of regions lost a significant part of their overnight stays.

3.2 Christmas and New Year's Eve

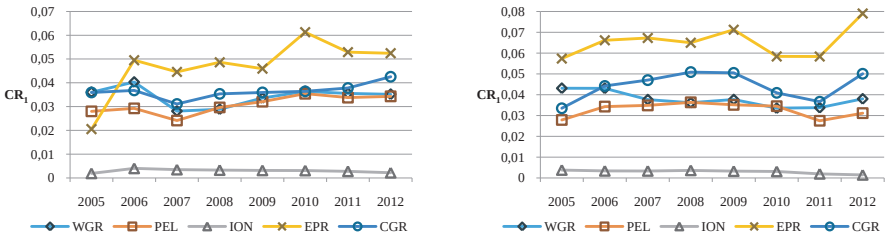
Christmas and New Year's Eve are two annual events that exhort tourists to travel. So we are interesting in seeking any seasonality in these two months (Figure 4). As it was expected, due to their geomorphology the region of Ionian Islands catch a very small share from the total overnight stays, while the rest of the regions get poor ones, probably a smaller share than it is expected.

3.3 Easter and Carnival

The last study period concerns, firstly, the seasonality of the month period including the Easter and then the month period that include both Easter and carnival period. For the first case we consider the months March to May and for the second the period February to May. The application of CR index in both of the periods is presented in the following charts (Figure 5).

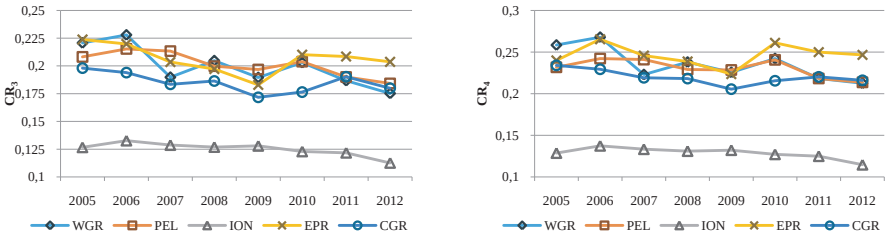
From the above Figures 5a and 5b we can see that all regions, except the Region of Ionian Islands, catch significant share of the annual overnights stays. This share for the second case (February-May) lies between 20%-25% revealing a significant seasonality in a period different than this of summer.

Figure 4: Christmas and New Year's Eve seasonality



a. January *b. December*

Figure 5: Seasonality on Orthodox Easter and Carnival



a. March-May *b. February-May*

4. Developing forecasting models

The other part of this work is to construct overnight stays forecasting models for each region. This section aims to complete the whole picture of the study of these regions by providing a comparison between the future (forecasting models) and the past behavior of these regions (seasonality). Therefore, for each of the study regions an overnight stays forecasting model is proposed based on ARIMA forecasting models. The development of the proposed models is taking place using the monthly overnight stays at all tourist accommodations (except from camping sites) from the regions of Western Greece and its contiguous areas, the Regions of Peloponnese, Ionian Islands, Epirus and Central Greece from January of 2005 till December 2012. The used data were obtained from the official records of the Hellenic Statistical Authority. It is noted that Hellenic Statistical Authority has not released any similar data for the period 2013 until now.

There exist several techniques for developing ARIMA models (e.g. Box & Jenkins 1976). However, in this work we prefer a mechanistic way of developing ARIMA models using the work of Hyndman and Khandakar (Hyndman & Khandakar, 2008) and the algorithm auto.arima of FORECAST package (Hyndman, and Khandakar, 2008; Hyndman, 2015). The auto.arima process is based on selecting models from a space model where the suggestion of the best model fitted to the given data is based on some information criteria (AIC, AICc and BIC). The overall development is implemented in R programming language (R Core Team 2015).

Since we aim to forecast on 12 month horizon, we divide our time-series data to a training set, which is constituted of all given observations, except the last 12 ones, and the evaluation set, which is constituted of the last 12 observations of the initial time-series. The evaluation set will be used to measure the performance of the proposed models before the actual forecasting is processed.

The auto.arima process is applied on the training set of each region and the following Table 2 describes the derived model, the estimated parameters, the performance of each model over the evaluation set, the results of the portmanteau tests (Ljung-Box and Box-Pierce test) and the results of residual normality tests (Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors, Anderson-Darling and Jarque-Bera tests). The main evaluation of the proposed models is realized over the evaluation set using as metrics the mean absolute percentage error (MAPE)

$$\frac{1}{n}\sum_{i=1}^{n}\left|\frac{P_i - A_i}{A_i}\right|, \quad (3)$$

and the root mean square error (RMSE)

$$\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(P_i - A_i\right)^2}\,. \quad (4)$$

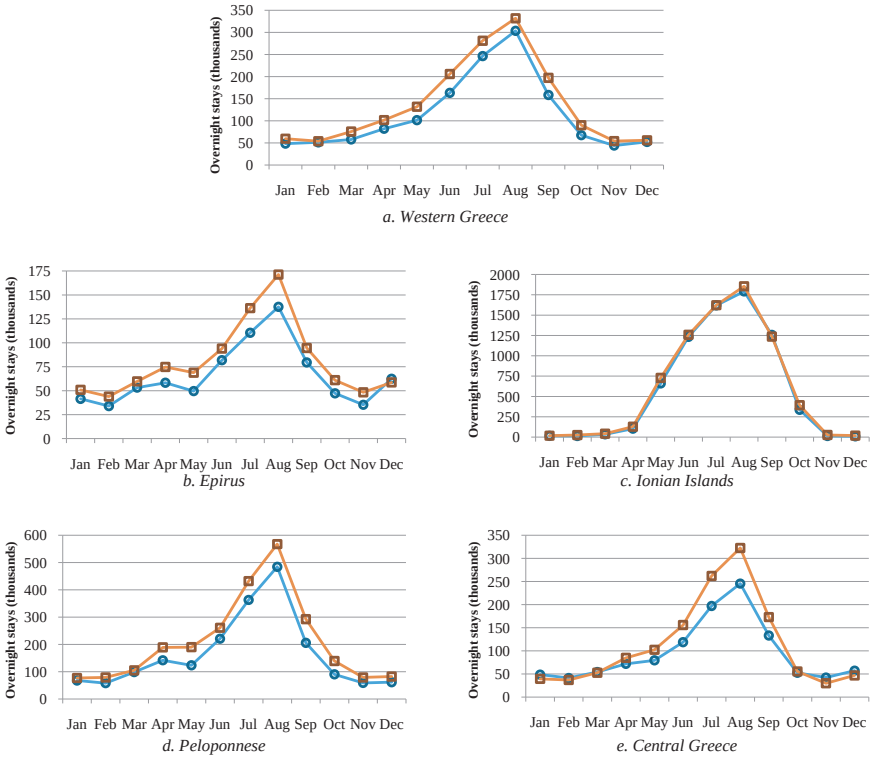
According to Tay and Cao (Tay, & Cao, 2001) the prediction ability of a time-series forecasting method should be evaluated using measures including MAPE and RMSE. These metrics are used to measure the correctness of the prediction in respect of the levels and the deviation between the actual and predicted values. The smaller the values, the closer the predicted values are to the actual ones. Beyond these metrics, for the completeness of this work we have also use some additional metrics to measure the performance of the proposed models as they appear in Table 2 and described in detail in (Hyndman, and Koehler, 2006).

A comment on the normality tests: In order to validate our assertion that,

Table 2: The resulting models for each region

	Western Greece	Ionian Islands	Epirus	Central Greece	Peloponnese
model	$(2,1,1)(0,1,0)_{12}$	$(1,0,0)(1,1,0)_{12}$	$(1,0,0)(1,1,0)_{12}$	$(1,1,1)(1,1,0)_{12}$	$(1,0,0)(0,1,2)_{12}$
ar1	1.0699	0.4713	0.5565	0.5894	0.6226
ar2	-0.3046	-	-	-	-
ma1	-0.9713	-	-	-0.9194	-
sar1	-	-0.4946	-0.508	-4.399	-
sma1	-	-	-	-	-0.7185
sma2	-	-	-	-	0.46
drift	-	-	298.3592	-	-
Performance Measurements					
ME	-21876.795	-21594.04	-14256.47436	-18321.33	-43254.768
RMSE	25372.59	34019.7	16871.222	34345.92	51034.2
MAE	21876.795	25059.47	14899.626	24578.548	43254.77
MPE	-20.853366	-27.323783	-22.7213906	-8.204942	-30.1525384
MAPE	20.853366	27.599429	23.750351	21.38321	30.152538
MASE	0.5182543	0.08466193	0.7259134	0.5103994	0.5607756
Portmanteau Tests (p-value)					
LB	0.81	0.98092	0.86831	0.99822	0.39673
BP	0.94016	0.99533	0.95392	0.99962	0.61401
Residual Normality Tests (p-value)					
SW	0.43421*	2.40E-06*	0.09702	0.33219*	0.06662
KS	1.22E-15*	1.22E-15*	1.22E-15*	1.22E-15*	1.22E-15*
L	0.00272*	7.46E-08*	0.00058*	0.0578	0.00075*
AD	0.09658*	1.00E-11*	0.02616*	0.10863*	0.02369*
JB	0.61483*	0.00523*	0.13998	0.80113*	0.1764

Figure 6: Ex-post forecasting: 2012 (circle: actual, square: forecast)

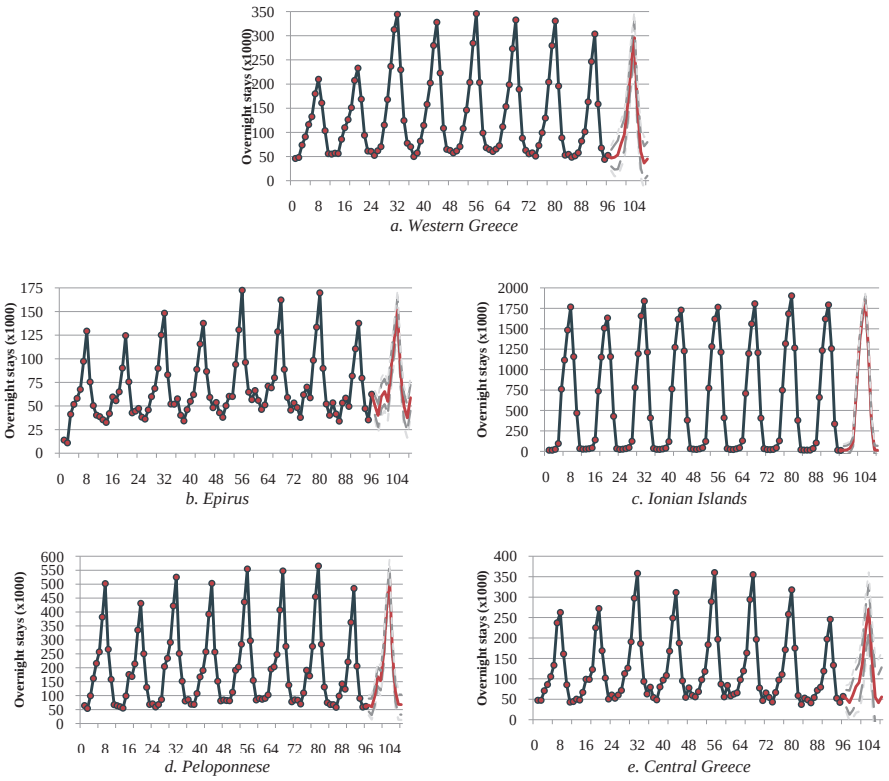


the majority of residual points follows the normal distributions, 4 outlier points were removed from the residual sets, the two smallest and the two biggest values (this is the case for values with * beside them), whenever the corresponding hypothesis was initially rejected. It is, also, clear from the table the algorithm auto.arima was not able to verify the reliability of the derived forecasting model for the prefecture of Ionian Islands.

The following Figure 6 shows the constructed models using the corresponding training sets of each region, forecasting over the corresponding evaluation sets.

For all models, the forecasts for the twelve months (period 85 till 96) are satisfactory because these values are close to real values and all of them are

Figure 7: Ex-ante forecasting: 2013



between the lower and upper limits. Finally, we predict the overnight stays in the regions for the next twelve months. The ex-ante forecasts from period 97 till 108 are presented in Figure 7.

5. Conclusions

In this work, motivated mostly from the crucial issues of seasonality and planning in tourism industry, especially in the region of Western Greece and its contiguous regions, we investigate the tourism demand on these areas studying the overnight stays in two stages. Firstly, the concentration ratio was applied to verify the evident seasonality of August through the years, but also to search

for time periods with concealed seasonality. Then, we predict the future of the current status of tourism demand in the study regions developing ARIMA forecasting models. These models were constructed using the auto.arima process and the study was done on monthly overnight stays from the Regions of Western Greece, Peloponnese, Epirus, Central Greece and Ionian Islands for the period 2005-2012.

From this study, it appears that the crisis has clearly affected the tourism flow in all regions, except the region of Ionian Islands. In these regions, a significant shrinkage was observed in annual overnight stays, increasing the seasonality, especially in August. This fact, along with the case of concealed seasonality in new periods during a year, should be taking into account by the tourism experts and policy makers to increase the tourism season in these areas and therefore the total income.

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The data that involves the monthly occupancy of all tourist accommodations of both foreign and domestic tourists came from the official records of the Hellenic Statistical Authority (EL. STAT., www.statistics.gr).

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COMPARISON OF THE NEOCLASSICAL SCHOOL OF WELFARE AND THE SCHOOL OF NEW WELFARE ECONOMICS

E. LERIOU*

Abstract

This paper analyzes the theory of welfare as founded and shaped by the basic two schools of economics thought i.e.the Neoclassical Approach and Modern Approach and furthermore on the view of echics and crisis. The main expressor of welfare theory is Arthur Cecil Pigou, whose work decisively determined the economic welfare and introduced as a subject of study of economics. Some favore dpigkouvian theory while others diversified. Through these trends, the theory of welfare developed and evolved in the history of economic thought.

JEL Classification: D60, B00, N00

Keywords: economic welfare, history of economic thought, crisis

1. Introduction

There are two main economic considerations of social welfare.The "Neoclassical Economic Welfare" or "Neoclassical Approach" with its main expressorsPigou, Marshall, Edgeworth, and the "New Economic Welfare" or "Modern Approach" with its main expressors Pareto, Kaldor, Hicks, Scitovsky, Little . The Jules Dupuit is the inventor of the producer and consumer surplus as the key welfare indicators. The Alfred Marshall made well known this index (tool) as the most suitable measurement tool, for that time, of the variation in welfare. Francis Ycidro Edgeworth nominated accurate utilitarianism which constitutes the main principle. Arthur Cecil Pigou is the main expressor of the "Neoclassical Approach" while central axis on which his theory was based, was the creation of simple, practical ways to promote welfare. Pareto which is the main expressor of the "modern approach" created a model known as "Pareto Optimization". Kaldor - Hicks established a "new Pareto criterion" also known as the "principle of compensation".

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2. The history of welfare

2.1. The neoclassical approach

The concept of consumer surplus was invented in 1844 by the French engineer Jules Dupuit. It was attempted for the first time to theoretically study the problem of assessing utility, proposing the use of the producer and the consumer surplus as a variation measure and hence as a welfare indicator. Alfred Marshall is a British economist from the University of Cambridge. Two of his students were Keynes and Pigou (Williams R., 1990). In his book "Principles of Economics" which was published for the first time the 13th of July 1890, the tool of the consumer surplus made well known (Whitaker J.,1990) specifying it as the most appropriate tool for measuring the utility or welfare variation, provided a steady marginal income utility (Marshall A., 1890).

So he is the one who introduced the consumer surplus, in economic theory, as the main analytical tool of welfare problems (Hicks J.R , 1941). On this analytical tool are based theories of Public Finance and Monopoly. Consumer surplus is the difference between the price the consumers want to pay and the price really eventually pay for the consumption of each product unit and is the sum of the surplus of each consumer. Therefore operates as a consumer welfare indicator. Marshall's theory is straightforward but relies on several specific assumptions. The main assumptions are:

- The utility function of each individual is independent and can be added.
- The marginal utility derived from a commodity decreases with the acquisition of each additional unit of the good.
- The marginal utility of income decreases with increasing consumers' purchasing power.
- While for a given purchasing power, the marginal utility of income is constant.

Samuelson describes the theory of Marshall as vague and confused, while describes the consumer surplus used as a welfare measurement tool, is the worst if not the most useless and unnecessary concept. Little agrees with Samuelson and adds that the consumer surplus is nothing more than a theoretical game. Yet economists insist until today to use this tool (Cowen T., 2000).

Francis Ysidoro Edgeworth is an Irish economist from the University of Oxford and a founding member of the generation of neoclassical economists in the late Victorian era (Newman P.,2003). The main feature of its contribution to economic science is his mathematical approach, making up important

tools like the "Edgeworth Box". He developed the general form of utility and indifference curves, while its precise utilitarianism which constitutes his main principle, as "the greatest amount of happiness of the intelligent beings solely based on numbers and distributions." He is deeply influenced by Plato and Aristotle, as he confesses, and he writes in ancient Greek, at various parts of his works.

AC Pigou is one of the main representatives of the Neoclassical Economic Welfare. The central axis of his theory was the creation of simple, measures to promote welfare. The basic framework of his analysis is based on two doctrinal proposals:

a) The welfare as a concept includes only statements that fall into the realm of consciousness, not in the realm of tangible things.

b) The well-being is something measurable, quantitative in the sense that it can be put in the category of more and less (Edgeworth F.Y., 1913).

Economic welfare can not be a safe barometer or indicator of overall social welfare. Recognizing the non-positive effect an economic reason may have to not economic welfare, so as to cancel the potential positive impact on economic welfare, however concludes that it is up to the jurisdiction of the society to choose between promoting economic or non economic welfare (Pigou C. A., 1920).

Pigou on his analysis gave a definition of economic welfare as "all the satisfactions and dissatisfactions resulting from the consumption of goods and services that can be measured in economic terms."

Economic welfare increases in the following four cases:

- When the total national product increases.
- When redistribution of the national dividend occurs in favour of the poor.
- When the volatility of the total national product decreases.
- When reducing the volatility of that part of the dividend concerning poor people

2.2. The modern approach

Pareto continues the work of Walras (Marchionatti R., et all 1997) and highlights the importance of the value of General Equilibrium. Accepting the indifference curves, he built a model from which the Pareto Optimization is deduced. Such a state of the economy is called Pareto effective if we can improve, through a reorganization of production and distribution the position of someone without prejudicing the position of another. The first who formulated this criterion was Edgeworth himself and not Pareto, so it would be

more correct to be called "efficiency criterion Edgeworth", instead "Pareto's...." (Jaffe W., 1972), but nevertheless prevailed to use Pareto's name. Pareto wishing to avoid the problem of interpersonal comparisons between individuals, proposed a criterion of economic efficiency, which deals with the economic situation of a social group. However, the Pareto-Efficiency criterion is a minimal sense of efficiency which not necessarily or inevitably leads to a desired resource allocations. In addition to this criterion, although it makes no reference to equality or to the overall welfare, is the basis of modern economic welfare. He developed the issue of inequality of income and concluded by a logarithmic equation that income distribution may be fixed for a specified period or for specified countries(Moore, L. 1897). A further conclusion is that the restriction of inequality can be achieved only by increasing the average income, a proposal that was originally formulated by Aristotle.

Pareto, unlike the classical scholars, does not admit that the utility is a concept that can be absolutely measured, but suggests a preference scale for each individual. Pareto replaced the utility concept, originated by Pigou, with the profitability concept, which is the function that measures the enjoyment that a person gets from the consumption of a commodity. In other words he measures satisfaction. In fact he simply removed the piece of psychological preferences and kept the experience in an attempt to remove ethics from the theory and give a more positive approach. The concluding degree of utility or lack of it, is a partial derivative of utility (Blaug M., 1992). So according to this change in the level of utility, spent or consumed during the use of productive services in the process of exchange or production, and the utility enjoyed or gained during the use of commodities or services, because of a change in production factors help to calculate the absolute change in the overall usefulness (McLure, 2001). Both changes are discussed in terms of a common good.

There are two basic theorems of economic welfare. The first states that any competitive or walrasian equilibrium leads to Pareto-efficient allocation of resources. The second one indicates the opposite, that every efficient allocation can be viable through a competitive equilibrium.

He shows a socialist system, where overall economic efficiency requires the same inputs as those which would be made in the system of free competition, and responsible for the formation of these inputs is the Minister of Finance if the distribution of income is determined exactly as if true free competition and responsible for this allocation of net income is the Minister of Justice. Pareto received harsh reviews for this approach to overall economic welfare.

Hicks and Kaldor introduced a "new Pareto criterion » known as the "principle of compensation" or "principle of potential compensation" (Hicks J.R.,

1939). According to this, a situation is socially desirable if the persons who will benefit, can compensate those who will be harmed and also there will be a surplus of benefit. This allowance is potential rather than actual.

According to «Scitovszky criterion" if beneficiaries can compensate the losers, it must be verified that the losers are not going to lose much in order to bribe their beneficiaries to avoid the change (Scitovsky 1941). Although Scitovsky belongs to the economic thought of the New Economics of Welfare, he does not opposed to the view of this school of independence of the satisfactions of different people - a view which Kaldor-Hicks adopted by Pareto and Barone. Scitovsky on the contrary, concludes that economists in the welfare field must make value judgments, but these judgments depend on interpersonal comparisons (Scitovsky T., 1951). Therefore accepts interpersonal comparisons in utility.

According to Little should take into account whether the compensation is actual or potential and suggested as a third criterion, called " the Little criterion" the value judgment, whether any distribution of income is socially desirable (Little , 1962).Little exactly like Scitovsky, although he belongs to the New Welfare Economics, advocates in favour of the interpersonal comparisons of moral or value- judgements and the inevitable connection of the welfare with ethics. Furthermore he examines these three issues with a manner associated with each other. He emphasizes on the refusal of interpersonal comparisons, because they are not objective and scientific as well as the value judgements, which has created extraordinary confusion in economic theory. While well underlining that the economic welfare engage in ethics, not because of their acceptance of interpersonal comparisons, but because of the ethics contained in welfare and because the terminology of welfare is an ethical terminology.

2.3. Comparison between the two approaches

In pre-industrial times they did not distinguish between positive economic and welfare economics. The Economic Science was called "Political Economy" and Adam Smith declared that it was the branch of science a political or a legislature would follow (Scitovsky, 1951). The distinction between positive economic and welfare economics began in 1920 (Zolotas E.X., 1982). It is, since 1920, customary to say that microeconomics is divided into positive or positive micro-economic and micro-economic theory of welfare or welfare economic. Positive economic deals with the operation of the economic system and is independent of value judgments, and the welfare economic is concerned with the provision of appropriate policies and the performance evaluation of

the economic system and is directly depended on ethics and subjective judgments.

Pareto is the founder of positive economic welfare. As a positivist rejected the ethical concepts of economic and naturally moral or value judgments of Neoclassical approach. This meant rejection of the interpersonal comparisons, since they were considered as moral judgments, and tried to find a social optimum position without the need of comparing various persons satisfactions (Drakopoulos St., 1989). The introduction of the concept of ordinal utility in the place of cardinal utility of Neoclassical approach, resulted to the economist shortcoming of making choices between two statements with economic feasibility. So the economic science as free from value judgments was separated from the Political Economy and the role of Economic was restricted. So it is Pareto that established the principle of scientific neutrality, i.e. froze up economic science which can not provide answers to many questions and it was holding a neutral stance. The global economic recession of 1929 altered the situation. Economists had to provide answers and solutions. They could not keep a neutral attitude. It was this neutral attitude that led to the crisis. Only if they accept interpersonal comparisons of Neoclassical could now choose between being prosperous or no (Scitovsky, T., 1951).

So the New Economic Welfare which was based on Pareto' positivistic approach rejected interpersonal comparisons as moral judgments. Kaldor-Hicks kept the same attitude as Pareto did. However, it is noteworthy that within their school were doubts about the foundations on which it relies. Little and Scitovskywere in favor of interpersonal comparisons and not agree with the treatment of value judgments as unscientific. They highlighted the problems caused by this attitude to serve the economic science and contradiction to reject the economists interpersonal comparisons while making interpersonal comparisons in order to decide on many issues (Little, 1949). It is worth noting that Little emphasizes the fact that the connection of welfare to ethics is inevitable even if we refuse interpersonal comparisons of Neoclasical because the welfare terminology is an ethical terminology. Therefore the non-correctness in the foundations of this school has been formulated from within. We conclude therefore that New School welfare features outstanding weaknesses, while the foundations of the building have been demolished by within. The question arises if we currently use the Pareto tool to investigate the welfare issues?

3. Conclusions

The theory of economic welfare is based on ethics and borders the science of philosophy, where it was born. Important role in shaping and historical evolution of economic thought of welfare as we know it today, played formalities, historically placed far behind the times that we tend to look at, when we investigate the economic welfare and particularly the formalities of Aristotle. Attempts were made to study the economic welfare in which Pigou gave great impetus, while two main streams were created. One which is expressed through the school of economic thought that he founded and the other one which differed mainly because did not accept interpersonal comparisons in utility, allowing the establishment of a second basic school of economic welfare thought having Pareto as its main representative. During this process, the theory of economic welfare began to move away from the ethics.

We conclude that the industrial revolution brought with it the need for skills and the prevalence of technocracy. In this context, the economic science should be removed from the ethics which does not serve the needs we appreciated at the time. For this reason positivist scientific method prevailed which was based on the assumption of the dominant role of the natural sciences to the social sciences. In economic science and specifically in the field of welfare, judgments abolished as anti-scientific. The paradox in this is that welfare as a scientific field was born from ethics and always will be dependencies. By now everything that was associated with ethics it was perceived as something harmful. So the economic welfare not only was unable to evolve but also froze for a while and no economist was not involved with this research field. The result was the crisis of '29. Economists seem unable to predict what was coming since no longer performed interpersonal comparisons and they did not enter in the paths of the welfare research field. They were forced to return to interpersonal comparisons because of the recession of '29 and to develop the welfare research field. But now the benchmark was not the utility but money. The crisis of '29 showed how the Pareto tool which rejects value judgments and thus the inevitable connection of ethics with welfare, is a useless tool and allowed eventually to return to interpersonal comparisons. Still today in welfare issues the Pareto tool is widely used in a blind manner.

The current crisis reveals again what has taught us the crisis of '29, that we should abandon the Pareto tool and to rely on a theory which accepts interpersonal comparisons and hence value judgments. This paper is based on the acceptance of interpersonal comparisons and value judgements . Additionally because the current economic crisis is considered by many people as

primary a moral crisis, leads us to ethics in general. So the era of the Industrial Revolution,the welfare was detached from the ethics because these were the needs of the time. The need of today because of the extensive global ethical and economic crisis is a return to ethics and any new welfare theory must be based on ethics.

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THE PRICES OF PLATINUM, PALLADIUM AND RHODIUM IN THE INTERNATIONAL MARKET BETWEEN 2006 AND 2012 AND THE IMPACT OF ECONOMIC AND OTHER FACTORS

A. ZOIS* S. ZOI**

Abstract

This article focuses on the fluctuation in the prices of platinum, palladium and rhodium, the three most commercially significant metals of the platinum group (PGMs). Those metals are not only the ones most widely used, but also the ones boasting the highest prices. Their most common application is in the sector of autocatalysts. We examine the period 2006-2012; in other words, we examine both years of economic progress but also years of recession of the global economy. The objectives of the article are to assess whether supply and demand predominantly affected the prices of those metals in the global market and to determine whether there are any other non-economic factors having impact on their prices- a deduction that seems to be valid.

JEL Classification: D_4

Keywords: market structure, pricing, demand, supply, metals

1. Platinum- Group Metals (PGMs) and applications

The platinum group metals-iridium, osmium, palladium, platinum, rhodium and ruthenium- are among the rarest commodities in the Earth's crust. Today, most of the world's primary PGM production comes from four countries- South Africa, Russia, Zimbabwe and the United States. The two most commercially significant PGMs are platinum (Pt) and palladium (Pd).

The leading demand sector for PGMs is the automobile industry in the field of catalytic converters to decrease harmful emissions from vehicles. Platinum, palladium and rhodium are used as oxidation and reduction catalysts in catalytic converters. Generally, the catalytic properties of the PGMs are outstanding. The other PGMs applications' sectors are the chemical industry, the electrical and electronic materials, the glass manufacturing, the petrochemical

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industry, the jewelry, the medical, biomedical and dental sector and finally as investment in the form of exchange-traded products, as well as physical bars and coins.

For example, in the electronics sector, PGMs are used in computer hard discs to increase storage capacity, in multilayer ceramic capacitors and in hybridized integrated circuits; in the glass sector PGMs are used in the production of fiberglass, liquid crystal displays and flat panel displays; in the chemical and petroleum sector, PGMs are used as catalysts in nitric acid and other bulk-chemical production (applications in fertilizers and explosives), in the refining of crude oil, reforming and other processes used in the production of high octane gasoline.

2. Introduction

Observing the 6 metals of the platinum group, we reach the conclusion that the ones of particular importance for further study are platinum, palladium and rhodium. This is due to the fact that those three metals have commanded the highest prices among all. Furthermore, only those three ones are used in the manufacturing of autocatalysts (needless to say that the greatest volume of their annual production has applications in this sector). After all, the sector of autocatalysts manufacturing is closely associated with economic prosperity.

In this essay we closely examine the period between 2006 and 2012 which includes both years of economic affluence and years of recession. The annual average prices of the three abovementioned metals, along with their supply and gross demand rates are mentioned in our study. Our objective is to ascertain whether the prices have been affected by the international economic situation; namely, if the prices have adjusted proportionally to the changes in the economy or if the changes in the prices are characterized by some degree of peculiarity. If the latter assumption is valid, we will be able to conclude that their fluctuations can be greatly attributed to other factors such as political expediency, strikes of workers in the mines, speculative games etc.

The troy ounce (oz) is used as a unit of imperial measure of mass. In the case of noble metals, one troy ounce is equivalent to 31,1035gr. The prices are measured in current US$ /ounce (oz), as they have been dictated by the stock markets of New York and in certain cases, London. The Johnson Matthey (JM) plc company has been the source of most of the numerical data used in this article, regarding the quantities (supply, demand) and prices of platinum (Pt), palladium (Pd) and rhodium (Rh).

In the following diagrams we can evaluate the trends of the world total

supply, the world gross demand and the annual average prices of platinum, palladium and rhodium between 2006 and 2012 (Figures 1, 2 and 3)

Figure 1: World Total Supply

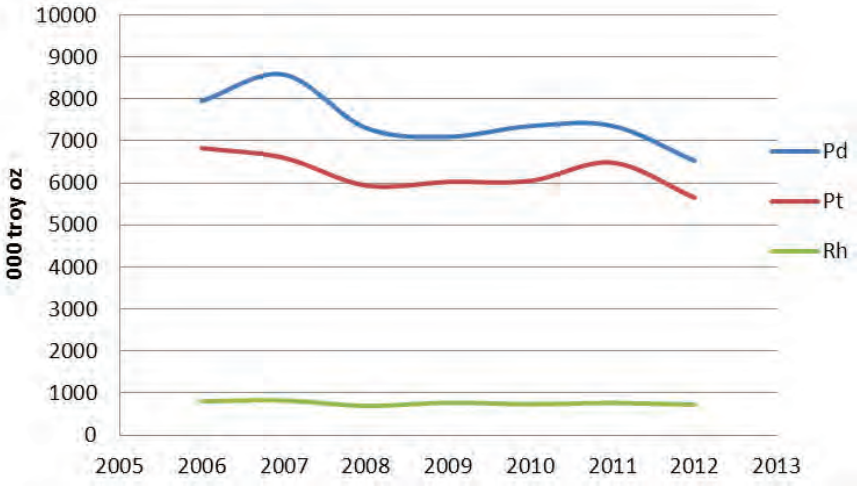


Figure 2: World Gross Demand

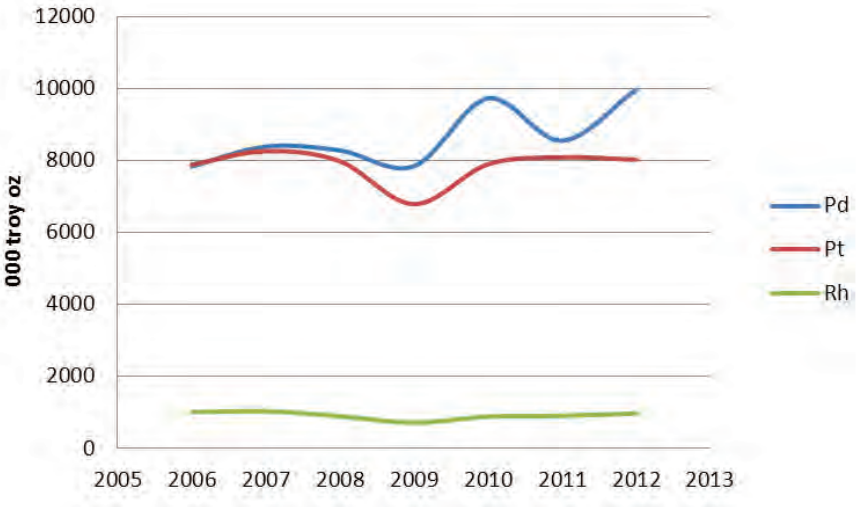
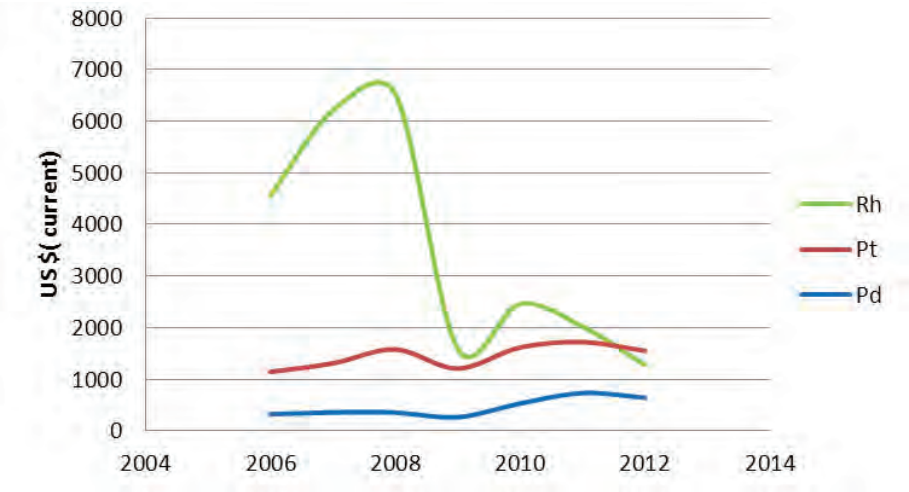


Figure 3: Annual Average Price in US $/troy ounce



3. Platinum

Platinum is found – often alloyed with other metals -in mineral deposits in South Africa, Russia, North America, Zimbabwe and other places all over the world. It has applications in various sectors such as the manufacturing of autocatalysts, the chemical industry, the electrical sector, the manufacturing of glass, the jewelry industry, the medical and biomedical fields, petroleum, as an investment etc.

The mining and production of platinum pose great difficulties as they require procedures that may last up to six months. It has been estimated that producing just one ounce of platinum entails the processing of 7-12 tons of minerals. The extraction procedure takes place in underground mines and begins with digging into rocks.

From 2000 onwards, the production of platinum in mines exceeds the number of 5.000.000 ounces per year. Especially in recent years, it is estimated around 6.000.000 ounces- production peaked at 6.830.000oz in 2006 and at 5.740.000oz in 2013. Contrary to this low annual production, the annual production of gold is estimated at around 80.000.000oz and the annual production of silver is about 800.000.000oz. Therefore, the price of platinum is considered to be high. Furthermore, as it has many uses and applications, in periods of economic stability and growth its price can even exceed the price of gold.

However, in periods of recession, we notice the exact opposite; the price of platinum drops because its demand in the industry is reduced. Usually, the price of gold is rather steady because its demand is independent of industrial uses.

The demand for platinum for the jewels industry increased dramatically, in Japan in the 1960s, then in Germany in the 1970s, followed by Italy, Switzerland, USA and Great Britain in the 1980s and in China, the most eminent jewelry market for the time being, in the 1990s. The first catalytic cars used PGMs and platinum in their catalysts in 1974. Last but not least, apart from its practical applications, the use of platinum as an investment was introduced in the 1980s.

The annual demand for platinum is covered by the centers of production, the products created by the recycling of inactive car catalysts, electronic devices and jewelry and finally, by the already existing stocks. For example, in 2012 the gross demand for platinum was 8.030.000oz; 70% of which (5.650.000oz) was covered by the total production, 26% of which (2.040.000oz) was covered by recycling and the remaining 4% (340.000oz) was covered by movements in stocks.

In 2012 it was also noticed that 72% of the production of platinum took place in South Africa, around 14% took place in Russia and the rest in the other geographic regions mentioned above.

Europe absorbs 25% of the total demand (2/3 of the total amount are intended for the autocatalyst industry), North America absorbs 14,6 % (1/3 of which is used in autocatalysts), Japan absorbs 14,4%(1/2 of the total amount is used in autocatalysts), China utilizes 28,4% (but only 1/20 of the total amount is used in autocatalysts) and the rest 4,6% of the gross demand is absorbed by other countries.

With regard to the matter of use, approximately 40% of the total demand (production, recycling and stocks) was intended for car catalysts while almost 35% was intended for the manufacturing of jewels. As far as the jewels sector is concerned, we focus on the market of China which is currently the leading manufacturer of platinum jewels. It is important to highlight that China also absorbed approximately 70% of the volume of platinum that was intended for the construction of jewels worldwide. Generally speaking, from the total amount of platinum that it imported, China used 85% in the manufacturing of jewels.

Last but not least, with regard to the amounts of metal that come from recycling, approximately 55% of the total quantity is used in autocatalysts manufacturing and 44% in the jewels industry.

Since the utilization of platinum is predominant in the production of car catalysts(as it facilitates the conversion of carbon monoxide CO and noncombustible hydrocarbons to carbon dioxide), we must stress that the amounts of PGMs contained in a catalyst range from 1 gr in small cars to 15gr in cars of great capacity. The catalyst of a medium car needs roughly 4-5 gr of the metal.

Focusing on the last three years of our study (2010-2012) we observe that the annual average price of platinum exceeded 1.500$ per oz. To be more specific, it was 1.552$/oz in 2012, 1.721$/oz in 2011 and 1.616$/oz in 2010. In a period of 40 years (1970-2010), the annual average price of platinum reached a peak in 2010 at 1.616$ per oz while its lowest point at 121$ was observed in 1970 and 1971.

In the next figures we can observe the curves of total supply, total gross demand and annual average price for Pt over the years 2006-2012 (figures 4 and 5)

Figure 4: Supply-Demand of Pt

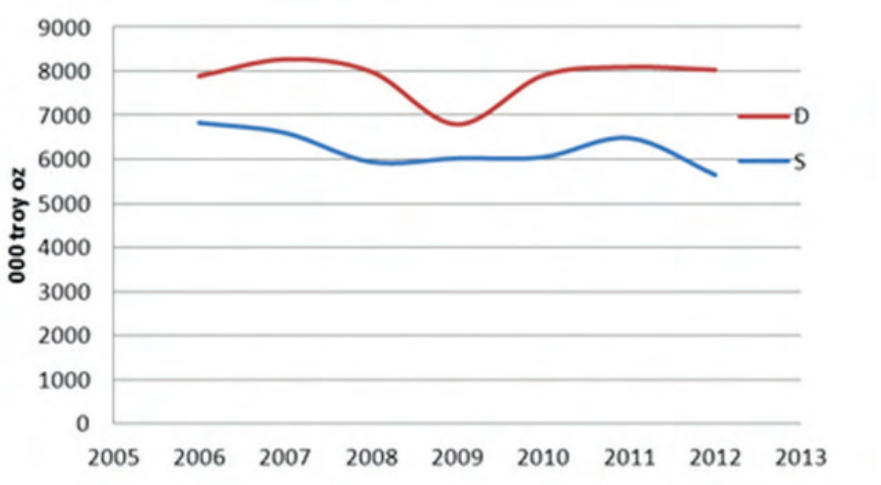
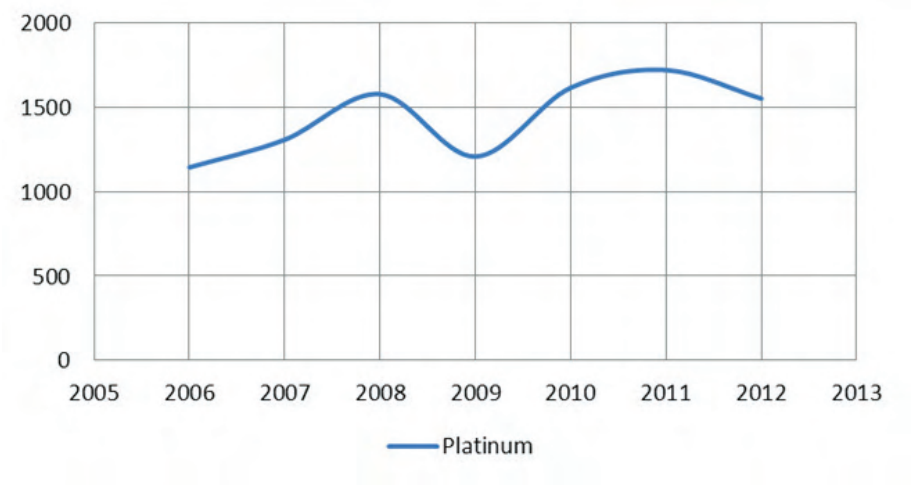


Figure 5: Pt Annual Average Price in US $/troy ounce



4. Palladium (Pd) and Rhodium (Rh)

Palladium is another metal of the platinum group that shares some characteristics with platinum but has a considerably lower price. It has applications in the sectors of autocatalyst manufacturing, the chemical industry, the electrical sector, the jewelry industry, the dental field and elsewhere. Also, it can be used as a form of investment too.

Contrary to platinum whose greatest producer is South Africa, palladium (according to 2012 data) is produced mainly in Russia (40%) and in South Africa (35,5%) as well. Its demand is associated with the sectors of autocatalysts (67%) and electrical applications (12%) while the sector of jewelry manufacturing comprises only 4,5% of the demand. According to 2012 data, the world total supply was estimated at 6.530.000oz while the world gross demand was estimated at 9.970.000oz. Consequently, the difference was covered thanks to recycling processes (2.290.000oz) and movements in stocks (1.150.000oz).

Europe absorbs 20,5% of the world gross demand while Japan absorbs 14,2%. North America comprises 26,5% of the world gross demand and China 20%. Approximately 70% of the above mentioned demand is related to the autocatalysts sector.

Ever since 2000, the world total supply has exceeded 5.000.000oz/year. As for the most recent years, it is estimated approximately at 7.000.000 (6.530.000oz in 2012, 7.360.000oz in 2011 and 7.355.000oz in 2010). As for the world gross demand, it is estimated at about 9.000.000oz in most recent years (9.970.000oz in 2012, 8.560.000oz in 2011 and 9.735.000oz in 2010). Similarly to the case of platinum, apart from the quantities produced, the world gross demand is covered thanks to recycling and to the movements in stocks.

However, the annual average price of palladium is relatively low compared to the annual average price of platinum. It is estimated around 650$/oz in recent years (643$ in 2012, 733$ in 2011 and 531$ in 2010). In a period of 40 years, from 1970 to 2010, palladium reached its peak price at 692$/oz in 2000 while its lowest price was at 38$ in 1970.

Due to the low price of palladium, efforts are made to replace platinum and also rhodium with palladium in the catalysts of the petrol engines of cars. In diesel engines, platinum is being used in the catalyst for the time being because the sulfur that is contained in the diesel poisons palladium more than platinum. The demand for palladium for catalysts increased considerably in the 1970s when the use autocatalysts was introduced.

In the figures 6 and 7 we can observe the curves of total supply, total gross demand and annual average price for Pd over the years 2006-2012.

The last metal of the PGMs that we will examine is rhodium, a very expensive metal that is also used in autocatalysts.

In 2012, the world total supply of rhodium was 722.000oz. Roughly 80% of the world total supply came from South Africa while 12,5% came from Russia. The rest comes mainly from North America and Zimbabwe. With regard to the gross demand (total 966.000oz in 2012) by application, we observe that more than 80% was intended to be used in autocatalysts, followed by applications in the chemical industry (8% roughly). Finally, the rest of the world gross demand was related to sectors such as glass manufacturing, the electrical sector and others.

Rhodium has certain advantages over the other PGMs, in what has to do with the reduction of nitrogen oxides NOx to nitrogen and oxygen.

The price of rhodium is high and is characterized by by noteworthy fluctuations. In a period of 40 years, between 1970 and 2010 the lowest annual average price was noted at 197$/oz in 1972, while the highest annual average price was 6.534$ in 2008. In order to understand the sudden and dramatic fluctuations in the price of rhodium, it's worth mentioning that in June 2008, its monthly average price was 9.745$/oz whereas in December of the same year it was barely 1.022 $.

In the figures 8 and 9 we can observe the curves of total supply, total gross demand and annual average price for Rh over the years 2006-2012.

Figure 6: Supply-Demand of Pd

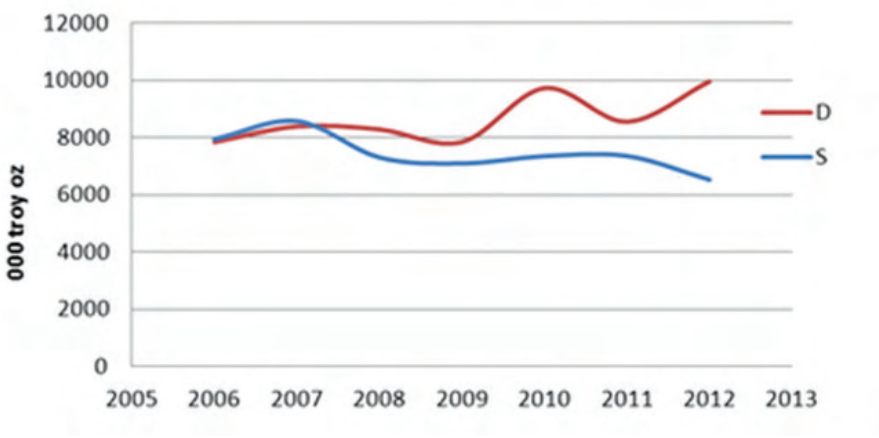


Figure 7: Pd Annual Average Price in US $/troy ounce

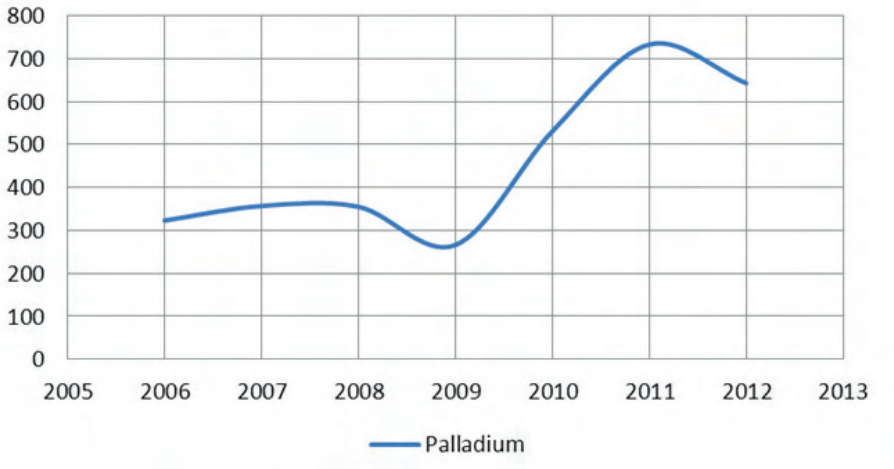


Figure 8: Supply-Demand of Rh

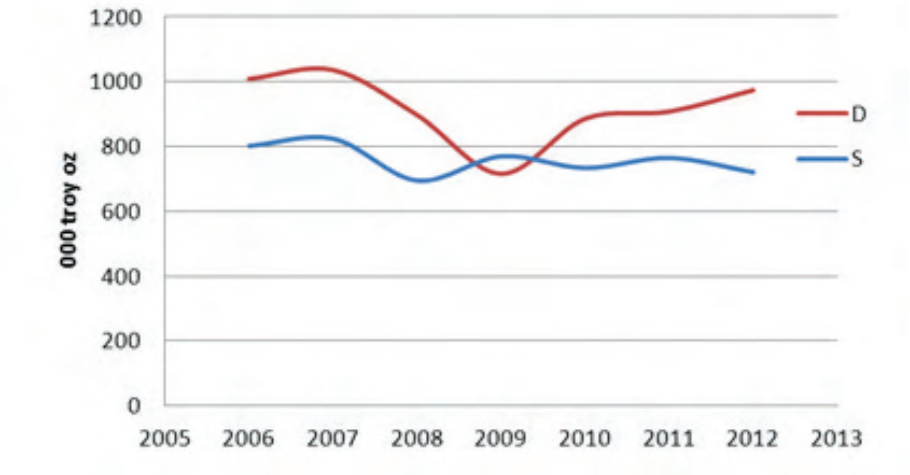
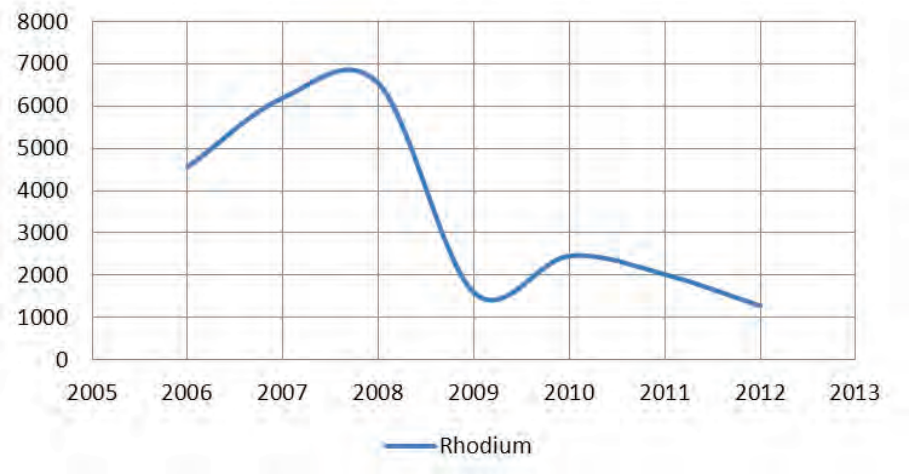


Figure 9: Rh Annual Average Price in US $/troy ounce



5. The period between 2006 and 2012. Supply, demand and prices of platinum, palladium and rhodium.

In the next tables we can observe the following pieces of information:

- Total supply and total gross demand (as well as their annual changes) of Pt, Pd and Rh counted in thousand ounces for the period 2006-2012 (tables 1 and 2)
- The annual average price of Pt, Pd and Rh in US$ per troy ounce as well as their annual changes for the period 2006-2012 (table 3)
- The deficit/surplus relationship between the supply and demand of Pt, Pd, Rh, counted in thousand ounces for the period 2006 2012 (table 4)

Table 1: World Total Supply in 000 troy oz

Year	Pt	Pt dif %	Pd	Pd dif %	Rh	Rh dif %
2006	6830	-	7950	-	802	-
2007	6600	-3,37	8580	7,92	824	2,74
2008	5940	-10,00	7310	-14,80	695	-15,66
2009	6025	1,43	7100	-2,87	770	10,79
2010	6050	0,41	7355	3,59	734	-4,68
2011	6485	7,19	7360	0,07	765	4,22
2012	5650	-12,88	6530	-11,28	721	-5,75

Table 2: World Gross Demand in 000 troy oz

Year	Pt	Pt dif %	Pd	Pd dif %	Rh	Rh dif %
2006	7890	-	7845	-	1009	-
2007	8270	4,82	8395	7,01	1036	2,68
2008	7990	-3,39	8290	-1,25	897	-13,42
2009	6795	-14,96	7850	-5,31	716	-20,18
2010	7905	16,34	9735	24,01	886	23,74
2011	8095	2,40	8560	-12,07	908	2,48
2012	8030	-0,80	9970	16,47	974	7,27

Table 3: Annual Average Price in US $/troy ounce

Year	Pt	Pt dif %	Pd	Pd dif %	Rh	Rh dif %
2006	1144	-	323	-	4561	-
2007	1308	14,34	357	10,53	6203	36,00
2008	1578	20,64	355	-0,56	6534	5,34
2009	1208	-23,45	266	-25,07	1591	-75,65
2010	1616	33,77	531	99,62	2459	54,56
2011	1721	6,50	733	38,04	2022	14,77
2012	1552	-9,82	643	-12,28	1276	-36,89

Table 4: Deficit/Surplus between Supply and Demand (in 000 troy oz)

Year	Pt	Pd	Rh
2006	-1060	105	-207
2007	-1670	185	-212
2008	-2050	-980	-202
2009	-770	-750	54
2010	-1855	-2380	-152
2011	-1610	-1200	-143
2012	-2380	-3440	-253

Observing the previous 4 tables, we can safely reach the following conclusions:

I. The prices of all metals rose in 2007 (in the case of the price of rhodium, the increase was significant)

The prices of all metals increased in 2008 (the price of palladium remained somewhat steady)

The prices of all metals decreased in 2009 (the price of rhodium plunged dramatically)

The prices of all metals increased in 2010 (in the case of palladium, the increase was considerable)

The prices of platinum and palladium rose in 2011 while the price of rhodium dropped

The prices of all metals dropped in 2012.

II. 2009 is regarded as a year of recession. The prices of metals decreased significantly, up to 76% in comparison with the prices of 2008. Also, the greatest annual percentage decrease in demand was observed. On the contrary, the sector of supply presents only slight changes. In contrast, 2010 was, undoubtedly, an outstanding year; the prices of all metals increased (in comparison with 2009) up to 100%. Last but not least, in 2010 we observed the greatest annual percentage increase in demand of the period 2006-2012. On the other hand, supply presented only insignificant changes.

III. Platinum has always suffered deficit between supply and demand. The lowest deficit of supply was observed in 2009. Palladium on the other hand, saw surplus in the years 2006 and 2007 but it has remained in deficit between supply and demand ever since. The highest deficit of supply point was in 2010 -when the price of this metal doubled -and also in 2012 (nevertheless, its price decreased). Rhodium has always suffered deficit between supply and demand and only in 2009 did it have surplus of supply when the price of this metal had plunged dramatically.

IV. The changes of the prices of these three metals are not proportional; not even in the cases of platinum and palladium which we can safely characterize as substitutes –to a certain degree– for certain uses. The highest and lowest annual average prices for the period 2006-2012 were the following:

Platinum: P_{max} 1.721$ in 2011 and P_{min} 1.144$ in 2006. Difference + 50,4%

Palladium: P_{max} 733$ in 2011 and P_{min} 266$ in 2009. Difference + 175,5%

Rhodium: P_{max} 6.534$ in 2008 and P_{min} 1.276$ in 2012. Difference -80,4%

V. The changes of the prices do not always follow the changes in supply and demand and even when they do, they do not present a relatively proportional rate of fluctuation. In other words, the principles of economic theory are valid only up to a certain degree.

VI. Platinum is characterized by perpetual, yet not dramatic, fluctuations in price. In other words, the fluctuations in the price of platinum are considered to be slight or moderate not only in the 2006-2012 period but also on an annual basis (i.e one year compared with the previous one).

The fluctuations in the price of palladium have been significant during the time period we are focusing on. Also, the prices change significantly from one year to the next.

The prices of rhodium have fluctuated dramatically in the period 2006-2012. The prices of rhodium are characterized by volatility even on a yearly basis. For example, its annual average price in 2008 was 6.534$, in 2009 it was 1.591$ and in 2010 it was 2.454$. As a result, in the period 2009/2008 we notice a -75,65% difference while in the period 2010/2009 we observe a + 54, 56% difference. Besides, statistically speaking, the coefficient of variation indicates that prices are disperse (cv >10%) in the case of all three metals. Rhodium presented the greatest degree of variability and thus, suffered the greatest degree of dispersion. Palladium came second in terms of dispersion and variability while platinum reached the third place as it presented the lowest percentage of variation (cv= 58% for Rh, cv= 36% for Pd and cv= 14% for Pt).

VII. The highest total supply for all three metals is observed in the years 2006 and 2007, in a period of international economic growth, and hence, in a period of industrial development. During this time, the gross demand was also high, particularly for rhodium. In 2007, the world demand for platinum and palladium intended for the autocatalyst sector reached a peak. Up to 2007, the demand for platinum and palladium for investment purposes was relatively low but as we entered a period of economic recession afterwards, it increased considerably. The demand for platinum as an investment increased from 170.000oz in 2007 to 455.000oz in 2012. Similarly, the demand of palladium for investment purposes rose from 260.000oz in 2007 to 470.000oz in 2012 (we must note that a remarkable year for the demand for palladium was 2010 when the demand reached the point of 1.096.000oz). In 2006, the world demand for platinum and palladium intended for autocatalysts was almost the same. However, due to the low price of palladium compared with the price of platinum, the demand for palladium followed an upward trend, until

2012 when palladium doubled its demand for autocatalyst use over platinum (3.190.000oz platinum and 6.705.000oz palladium).

6. Unpredictable incidents having an impact on the prices and the current situation

Various incidents, especially sudden ones, may have a serious impact on the prices. Some examples of such incidents may be the strikes of workers in the mines, the policies of states that produce PGMs, the strategies that the companies of production follow and the economic circumstances. As for the latter, when the economic conditions are unfavorable, as a rule, the industrial activity is limited; therefore, demand is generally limited as well. However, the demand for other purposes, such as investment or financial safety often increases. In the case of platinum and palladium, we also ought to take into consideration the factor of speculation since the prices are formed at the stock markets such as the ones of New York and London.

We believe that the abovementioned factors are of high importance, because in the market of PGMs, the supply cannot square with an increased demand since the mines are finite, it takes a lot of time to extract and produce the metals –often months- and the cost is high. Therefore, it is safe to conclude that supply is characterized as inelastic, to a certain degree at least for a short time period. Thus, demand is also covered by recycling and movements in stocks.

We can enumerate various unanticipated events. We shall report some quite recent incidents:

By the end of 2000, Russia announced that no further amounts of PGMs would be sold. This led the users of palladium to create stocks. Consequently, its price soared. So, while the monthly average price of palladium was 784$/oz in November 2000, it increased to 910$ in December and it further increased to 1.041$ in January 2001 (the peak price it reached at the stock market of London was 1.090$/oz on 26th January 2001). In a period of 25 roughly years, from the beginning of 1992 to the end of 2015, the price of palladium had never exceeded the 1.000$ limit apart from the time period that we just mentioned (figure 10). Ford (the car company), fearing the discontinua discontinuation of production by a possible lack in palladium -used in the car catalysts, allocated huge amounts of the metal from its stock reserves. It is important to note that by the end of 2001, the price of palladium, had plunged to 398$/oz (monthly average): the same year, (early 2001), the price of gold was estimated at approximately 300$/oz and the price silver was around 5$/oz; quite low, in other words, while the price of platinum was estimated at approximately 600$/oz.

In 2008, South Africa faced political problems and unrest. As a consequence, the spot price of platinum soared to almost 2.300$/oz (March 4 2008, 2.273$, London). During the same period (early 2008), the price of palladium was around 300$/oz, gold was estimated at about 900$/oz, the price of silver was estimated up to 20$/oz while rhodium reached the all-times record spot price of approximately 10.000$/oz in June 2008 (figures 11 and 12).

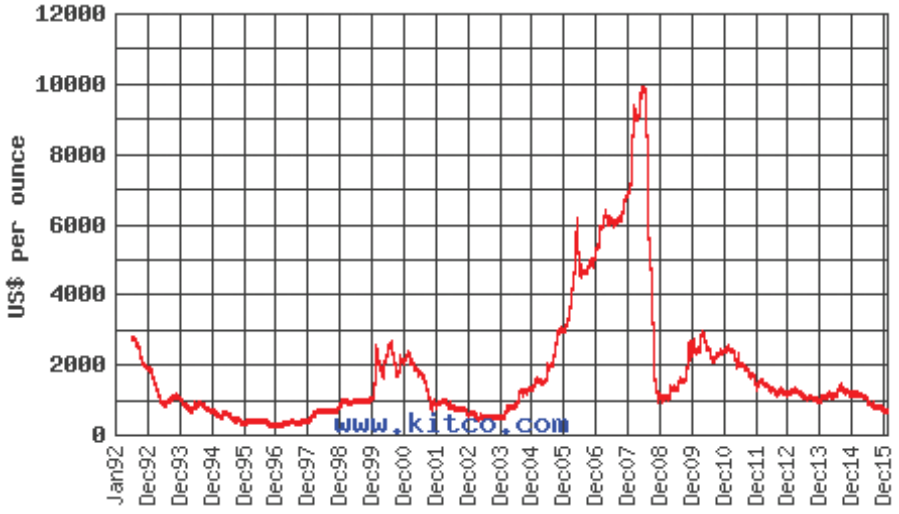
Figure 10: Palladium - London PM Fix 1992 - present

Source : Kitco Metals Inc

Figure 11: Platinum - London PM Fix 1992 - present

Source : Kitco Metals Inc

Figure 12: Rhodium - London PM Fix 1992 - present

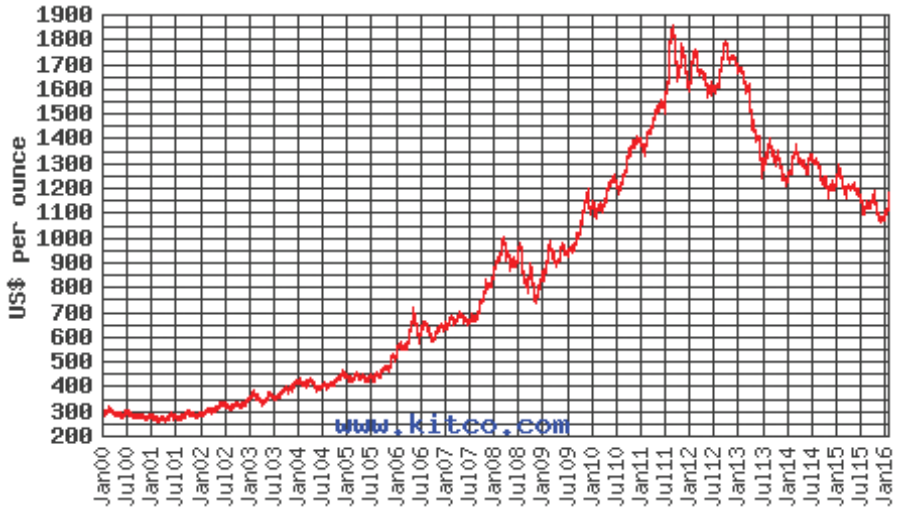


Source : Kitco Metals Inc

As for gold and silver, it is worth reporting some data that emerged in the period we are focusing on, the period 2006-2012. In the last 15 years, in other words in the years between 2000 and 2015, both gold and silver reached their peak prices in 2011, at about 1.800$/troy oz and at 45$/troy oz respectively. These are important figures if we take into consideration that the years immediately before and after 2011 are not considered to be "good" years for the global economy.

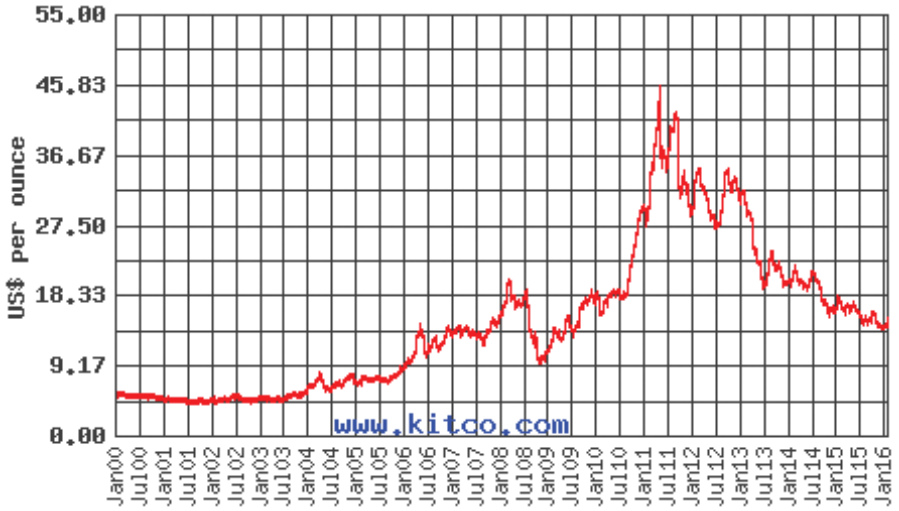
The prices of gold and silver for the period 2000-2015 are outlined in the following figures:

Figure 13: Gold - London PM Fix 1992 - present



Source : Kitco Metals Inc

Figure 14: Silver - London PM Fix 2000 - present



Source : Kitco Metals Inc

The prices of the metals we are examining, along with gold and silver are outlined here as they were documented in the end of 2015 (spot price London 24 December 2015):

Gold 1.071, 10$/oz
Silver 14, 32$/oz
Platinum 867, 45$/oz
Palladium 551, 91$/oz
Rhodium 650$/oz (estimation)

Finally, another factor that we ought to take into consideration is the cost. In 15 September 2015, Eric Norland (CME Group) argued that in 2014 the cash cost of producing platinum was1.209$/oz. That was about 20% above the current price. In contrast, the cash cost of extracting gold was estimated at 700$/oz, or above 40% below the current prices.

7. The PGMs market. Conclusion

The PGMs market can theoretically be characterized as an oligopoly. In theory, the oligopolist wants to increase supply, but this will result in the reduction of the price of the product. Thus, oligopolists do not follow the process of competitive enterprise where the offer increases until the price equals the marginal cost of the product. Oligopolists strive to shift to some type of monopoly by forming collaborations with each other and producing smaller quantities of a product which they will sell in higher than the marginal cost prices.

The market of the three metals that we focus on is characterized as oligopolistic, as far as the enterprises and the countries of production are concerned. In other words, only a few enterprises and only a few countries produce significant amounts of metal. However, the application of oligopolistic policies by the producers is practically difficult (and an agreement of cartel type is even more difficult) for the following reasons:

- The countries of production serve their own economical and political interests (expediency)
- The enterprises of production take into account the governmental policies
- Sudden incidents and unanticipated factors can occur in the market
- The metals are not products intended for immediate use. They offer a lot of uses, among which is the use for investment. Also, the phenomenon of speculation cannot be overlooked.

Taking everything into consideration, it seems that supply and demand are not the sole factors that determine the price of PGMs from a strictly economic viewpoint, that is to say from the spectrum of the international trade and the international economic situation. Other, not economic factors (unpredictable factors, political factors, speculation etc) also play a major role.

In a future article we will examine a long period of 40 years and using forecasting, normal distribution and hypothesis testing, we will try to assess the extent to which non- economic factors affect the price of PGMs.

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