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Pricing of Sugar Beet Based Biofuels in Turkish Energy Market

Vedat YORUCU[1], Ilhan BORA[2], Dervis KIRIKKALELI[3]

Abstract

This study aims to investigate the pricing of biofuels in Turkish energy market. The traditional the Central Bank of the Republic of Turkey's discount rate pricing approach may not be applicable for pricing biofuels in Turkey. The weighted average cost of capital (WACC) expenditure approach, which was implemented by the MIT Energy Initiative for Natural Gas Monetization has been used in this study to model sugar beet based biofuels pricing in Turkish ethanol market**.** The results reveal that weighted average discount rate provides more realistic returns than the one offered by the Central Bank of the Republic of Turkey. The findings also indicate that investing in sugar beet based biofuels in Turkish ethanol market results negative returns. Biofuels technologies are stabilized and mature, and became viable and directly competitive with hydrocarbons when the crude prices started to increase during the period 2001-2014, especially ethanol, benefiting from the permanent improvement from the alcohol program in Brazil. A similar trend will probably be followed by biodiesel technologies, yet not for Turkey.

Keywords: renewable energy, biofuels, WACC, Turkey.

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Introduction

Energy supply security, greenhouse gas emissions and the impact of energy cost on the economic and social development are the important topics in the EU's agenda (Tilman *et al*., 2009; Soytas and Sari, 2009; Menegaki, 2011; da Graca Carvalho, 2012). There is a world-wide acceptable consensus about the significance of renewable energy, like bioethanol. However, one of the most important disadvantages of bioethanol against fossil fuels is economic competitiveness. This technology is stabilized and mature, and became viable and directly competitive with hydrocarbons when the crude price started to increase during the period 2001-2008, especially with ethanol, thereby benefiting from the permanent improvement of the alcohol program in Brazil. A similar trend will probably be followed by biodiesel technologies. For example, in Brazil two thirds of the sugarcane crop will be used for ethanol by 2017/2018 according to OECD-FAO agricultural outlook 2011-2020 (OCED, 2011). The price projections for biodiesel are the reverse of those for ethanol, with OECD – FAO projecting a small increase of around 12% compared to FAPRI's forecast of nearly 70%. Considering prices and costs, in particular for the bioethanol production in Turkey, it is subject to a special attention. Therefore, investment decisions on biofuel energy investments in Turkey (either by private or public sectors) require different risk considerations, which is subject to analyses different discount rates.

Different discount rate applications are available for public and private investments. The calculation of discount rates varies based on risk levels (Arrow & Lind, 1978). Private risk is inherently greater than social risk and most of government projects related with cost and benefit analysis take into account risks, which are distributed over the entire population of the country. Insuring risks through public finance perhaps is the cheapest way to release costs that may be incurred. Does the typical private firm face any risk which is equal to or greater than those faced by the local officials? To appraise these risks, we have to analyze the distribution of risks, which are caused by the costs and benefits. This analysis should include households to identify the impact of risks on their portfolio. After clarifying the risk differences that are incurred between private and public investments, the aim is to investigate its impact on the sugar beet base ethanol production in Turkey. In the literature, there are several available approaches regarding the calculations and implementation of discount rates; however, no clear conclusions have yet been made by any researcher about the accuracy of existing discount rates due to its own different special conditions.

Uzunkaya (2012) argue that discount rate applications may have disadvantages and advantages. Being a low discount rate, an investment with a low rate of return may result in a lower and negative return. When the net present value (NPV) becomes negative, indicating that there will be no aggregate benefit considering that project (Osborne, 2010; Mackevicius & Tomasevic, 2010;

Wiesemann *et al*., 2010; Bierman and Smidt, 2012). In the case of high discount rate applications, the results may be just the opposite, which may have social benefits in the economy. Therefore, it is rational to consider the average and rational percentages of discount rates for biofuel investments in Turkey. Considering the renewable energy industry, such as solar, biofuel and wind energy, either approach may produce positive feasibility returns for the investment of renewable and green energy (Masini & Menichetti, 2012; Lehr et al., 2012; Chen *et al*., 2014). Nonetheless, producing biofuel has another issue because it has more value added effect for the agriculture industry and is perhaps for the time being, the only alternative energy for transport fuels. Solar and wind energies are more domestic and becoming more viable as technology is continuously improving. The expectation is to have the same tendency of technological development in the biofuel industry; however, raw materials, such as sugar beet and sugar cane for biofuels have different cost prices depending on the type of biofuel used (Naik *et al.*, 2010; Nigam & Singh, 2011; Klein-Marcuschamer *et al*., 2012)

The major price indicator for biofuel energy is the Brazilian sugar cane based biofuel (Mussatto et al., 2010). The world biofuel price equilibrium is mainly affected by Brazil's price policy. Brazil has price dominancy for biofuel being the main supplier of bio-energy for the rest of the world. The UK Treasury uses a public sector discount rate of 3.5 percent over a 30 year period, recognizing the significant short-term costs and longer-term benefits of such projects. Treasury (2003) clearly stated the guide the UK Treasury analysts use to make investment appraisals on specific public projects, recommends a discount rate of 3.5 percent, which has reduced from the previous rate of 6 percent. More importantly, the UK Treasury places emphasis on separating the risk assessment and fund rationing elements from the discount rate, which explicitly uses the rate to account for time preference, rather than the other (implicit) assumptions. A project's risk is then handled through a different process, usually in the form of a separate risk assessment report.

The EU guidelines ,however, suggest that the discount rate for public transport infrastructures is not more than 6 percent and that the European Parliament has made some recommendations to implement a guideline of 5 percent rather than 6, depending on the cost of capital and interest rates applicable to each individual state member. However, in practice the application of discount rates has, at times, been lower than 3.5 percent, particularly regarding "structural adjustment" infrastructure funding for newly joined state members of the EU. The EU has applied a zero percent discount rate to certain project proposals from member nations under specific circumstances (Caplin & Leahy, 2004). In addition, a number of economists have supported a real discount rate of zero based on removing the assumption of a time preference applications on investments. However, a near-zero social discount rate forces decisions to be made in the present period about highly uncertain events (or benefits) that are expected to occur in the distant future even though the estimates are highly speculative. Despite this counter argument, some countries have applied a zero discount rate to some infrastructure projects, even if not stated explicitly. Countries such as France has used a zero discount rate for certain projects, particularly where a future benefit is envisaged to outweigh the present benefit. A number of new EU member states (the East European) have applied a zero or near zero discount rate to many of their allocated infrastructure projects from 2007 to 2013. The rationale for this was based on coordination failure and externality arguments, which have been applied in those cases where there were significant deficits in the core infrastructure.

Burgess and Jenkins (2010) emphases the appropriate discount rate for evaluating public private partnership (PPP) projects provide a convenient opportunity to review the issues surrounding the determinants of a discount rate. Although producing beet sugar is more costly than cane sugar, we are not sure if producing biofuel from beet sugar will reduce fossil fuel dependency in Turkey. The future benefit of biofuel production in Turkey is not precisely known, especially for employment, energy security, household benefits, and the environment (Erdal *et al*., 2009; Icoz *et al.,* 2009; Acaroglu and Aydogan, 2012; Aksu, 2016; Turhana and Gündogan, 2017). Decreasing fossil fuel dependency and eventually reducing the balance of payment deficits in the Turkish economy, motivates researchers to reconsider the calculations of discount rates in the bioenergy industry and to conduct new calculations for biofuel discount rates in Turkey.

Theoretical approaches of discount rate applications

The conventional discount rate application proposed by Clark and Stevens (1995) is based on the following formula:

$$R = \frac{I}{P^*}\frac{365}{D} = \frac{\frac{\frac{I+P}{I}}{P}}{P+I^*}\frac{365}{D} \qquad (1)$$

where I denotes interest rate, P denotes principal amount borrowed, C stands for C=I/(P+I) whereas R stands for the effective annual discount rate and finally, D denotes the number of days the loan was borrowed.

Some risks are not diversifiable and that part of the pre-tax and after tax rate of return will reflect a premium for bearing risk. Whether this premium should be netted out in determining the appropriate social discount rate depends upon whether the government can pool and spread the risk so as to eliminate it. If a government's ability to pool and spread risk is no better than the private sector's, there is no justification for adjusting the rate of return forgone in the private sector to arrive at lower social discount rate. if the economy is well integrated into the capital markets, a significant proportion of the funding will come from abroad as net exports, which are displaced compared to investments and consumption. The social discount rate than becomes a weighted average of P, with R being the marginal cost of incremental funding. This formula, the shadow price algorithm, was proposed by Eckstein (1957) and refined and extended by Marglin (1963), Feldstein (1972), Bradford (1975) and Arrow and Lind (1982). Eckstein's approach claims that a weighted average discount rate commits an aggregation error when combining two distinct prices, such as combining the price of future consumption in terms of current consumption and the price of investment in terms of consumption into one discount rate. However, the most recent studies (MacDonald, 2010; Paltsev *et al.*, 2013) used weighted average approaches.

Discount rates of a country or economy or industry shows different responses to different economic and financial shocks. When there is a sudden increase in interest rates, different firms and industries react, differently (Cochrane, 2011). There is general understanding that it is better to compute a firm's discount rate rather than for an industry. Therefore, every new discount rate that is dynamic, changes the financial performance of a firm's investments. This is certain for sure but when it comes to the energy sector, in particular to renewable energy, discount rates show an increased negative response reaction more than expected. This is because energy imports are one of the causes for disrupting a nation's balance between payment deficits. It is worth to note that an energy crisis will always increase the economic and financial viability of the energy industry. Especially, for example, an increase in fossil fuel prices will give an opportunity to the supplier to produce and sell more biofuels under better conditions. So, as sustainability increases in the renewable energy market, the discount rate of the industry will decline to lower levels. At the same time, there is still confusion about how to handle discount rates for renewable, and how to calculate them.

The central idea for computing discount rates therefore depends on the cross-section of expected returns driven by the capital asset pricing model (CAPM). In this study, the WACC approach has been implemented, which has been previously employed by MacDonald (2010) and Paltsev *et al*. (2013) in the feasibility study for the Energy Initiative for the Natural Gas Monetization of Cyprus and the Eastern Mediterranean region.

Findings

Discount rate is used to compute the NPV and IRR of a project and its expected return on investments. Discount rates are sometimes used as a best revenue option that is forgone due to new investment opportunities and sometimes it is the shadow revenue or price. Today's risks are different than tomorrow's risks and of those in the past. For example, the risk rate (in percentage) for a power plant that is 50 years old is different than the risk rate for a new solar energy firm today. So, there is a need to define and compute the risk for a 50 year old power plant compared to today's new form of energy. The business environment is changing very fast and it will continue to change in today's more dynamic environment. Due to the rapid changes in technology, in the environment and with the living style of today's generation, the threats are becoming opportunities and opportunities are transformed back into threats. It is difficult to stabilize everything but we try to adapt to the changes by applying changeable discount rates. The focal point of this paper is therefore to deal with different risks but compound them according to the industry and preferences of its investors. The Social Discount Rate (SDR) is another forgone opportunity with public and private investments. Whether a government is investing or a private company, they both utilize the same national resources, which have costs to the community. The starting point for cost and benefit computations are therefore relying upon the works that mirror the social aspects of a given society.

Today`s costs and the future costs together with the todays cash inflow and cash inflow projections are calculated with discount rate in order to find todays present value, this computation is called discounting and it's for calculating the time value of that cost and benefits. Discounting the time value of money is not same compared to accounting for inflation because discounting is applicable even if there is no inflation. When used and compute appropriately, discounting the future unit currency provides a more accurate figure assessment of an initiative's economic impact.

It is worth to stress once more the importance of a discount rate choice before using it whenever conducting a discounted cash flow analysis. Since the discount rate is such an important measure, prior to computations no one could hesitate to follow the Discounted Cash Flow (DCF) method. To be able to arrive at your discount rate, one of the underlying parts of the computation defined as cost of equity. Also cost of equity defined as return percentage who stockholders expect to receive. And if the stockholders do not like percentage of return to their investment, they might show selling patterns of their stocks. So firm must consider this rate of return percentage in order to keep the support of demand in the stock market.

Different cost of equity studies are produced by the valuation experts, they usually have three components in common, such as risk-free rate, beta and equity risk premium, respectively. The risk free rate typically corresponds to what an investor expects to receive from investing in a security with zero risk. Even the safest investment vehicles (i.e., U.S. and Turkish Government bonds) cannot be truly risk-free, yet they are the closest ones. The portion of a U.S. Government bond that is virtually riskless is its yield. Thus, most use the yield on a long-term U.S. Government bonds as their risk-free rate. The beta or industry risk premium attempts to quantify a company's risk relative to the market.

The WACC approach can be used as a discount rate for evaluating investment projects. Such a method has been used by Paltsev *et al*. (2013) and MacDonald (2010) for the feasibility study of the Cyprus' natural gas monetization and for the pipeline construction projects among North African countries, respectively. According to Lurin (2010), the WACC simply refers to how much money should an investment company raise for a planned investment? Projects can be financed by debt or equity and typically, companies use a combination of both. The WACC reflects the cost of debt and equity financing, weighted for the mix of financing. The WACC may vary from company to company because the cost of debt, the cost of equity, and the weight depend on a company's individual circumstances. The inflation rate is an implicit cost for the WACC estimations. The WACC formula can simply be expressed as:

$$\text{WACC} = \frac{\text{Market values of the firm's equity}}{\text{Market values of the firm's equity} + \text{Market values of the firm's debt}} * \text{Cost of equation} + \frac{\text{Market values of the firm's debt}}{\text{Market values of the firm's equity} + \text{Market values of the firm's debt}} * \text{Cost of debt} * (1 - \text{Corporate taxe rate}) \quad (2)$$

And the cost of equity and cost of debt are simply calculated as follows:

$$Cost\ of\ Equity = Interest\ rate + Equity\ Risk\ Premium + Company\ Beta \quad (3)$$

$$Cost\ of\ Debt = Company\ bond\ yield + geopolitical\ risk\ premium \quad (4)$$

Net Present Value (NPV) is a formula used to determine the present value of an investment by the discounted sum of all cash flows received from the project. The formula for the discounted sum of all cash flows can be rewritten as:

$$NPV = -C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_n}{(1+r)^t} \quad (5)$$

When a company or investor takes on a project or investment, it is important to calculate an estimate of how profitable the project or investment will be. In the formula, the $-C_0$ is the initial investment, which is a negative cash flow showing that money is going out as opposed to coming in. Considering that the money going out is subtracted from the discounted sum of cash flows coming in, the net present value would need to be positive in order to be considered a valuable investment.

Table 1. Beta coefficients and expected return on investment for second-generation biofuel companies

Company	Ticker Symbol	Beta	Required Return
Amyris	AMRS	1.4	10.60%
Gevo	GEVO	4.1	26.70%
Green Plains Renewable Energy	GPRE	1.3	9.60%
KiOR	KIOR	-0.9	-3.60%
Lignol Energy Corp.	LEC.V	1.4	10.30%
Pacific Ethanol	PEIX	3.2	21.20%
Rentech Inc.	RTK	3.4	22.70%
Solazyme	SZYM	2.4	16.50%
Verenium	VRNM	0.6	5.60%

Source: Moody's (2014)

The average return of capital is around 15 percent for a biofuel industry. The beta coefficient for the companies listed in Table 1 is more than 1.0 (β>1), which means that the risk is highly volatile. This beta coefficient has been extracted from Moody's (2014). In Table 1, we computed the average of the Beta coefficient for the biofuel industry, which is equal to 1.87 =

$$\frac{(1.4+4.1+1.3-0.9+1.4+3.2+3.4+2.4+0.6)}{9}$$

Before proceeding with the WACC, R_e has to be calculated which gives the required rate of return on equity. The R_e formula is given below:

$$R_e = r_f + (r_m - r_f)^* \beta \qquad (6)$$

where r_f indicates risk free rate for biofuel production in Turkey and r_m stands for the market rate in Turkey. The market risk premium of Turkish Economy can be obtained by subtracting r_f from rm. The beta coefficient (β) represents the unsystematic risk for biofuel industry in Turkey. The beta coefficient is calculated as 2.37 by taking the average coefficients of 9 different biofuels manufacturing companies from the countries listed in Table 2. The r_f represents the risk free rate of 9.25 percent and it is extracted from the sources of Central Bank of the Republic of Turkey as Turkish economy treasury bond rate. The r_m denotes 12.5 percent is obtained from Turkey Business Bank (Isbank) and as a market rate for the private sector. The difference between r_m and r_s is equal to 3.25 percent (r_m-r_f= 12.5%-9.25%= 3.25%). To be able to calculate return on equity, we sum all of the data as R_e=0.0925+0.0325*2.37 and R_e becomes 0.17 percent.

Table 2. Biofuel Manufacturing among the selected countries

Country	Long-Term Rating	Adj. Default Spread	Total Risk Premium	Country Risk Premium
Thailand	Baa1	100	6,41%	1,50%
Trinidad and Tobago	Baa1	100	6,41%	1,50%
Tunisia	Baa2	115	6,64%	1,73%
Turkey	Ba3	300	9,41%	4,50%
Turkmenistan	B2	400	10,91%	6,00%
Ukraine	B1	350	10,16%	5,25%
United Arab Emirates	Aa3	60	5,81%	0,90%
United Kingdom	Aaa	0	4,91%	0,00%
United States	Aaa	0	4,91%	0,00%
Source: Moody's (2014)				

Considering the weighted average cost of capital calculation for the biofuels production in Turkey, we can construct the WACC formula as follows:

$$WACC = \frac{E}{V^{*}R_e} + \frac{D}{V^{*}R_d^{*}(1-T_c)} \qquad (7)$$

where; $\frac{E}{V}$ stands for the percentage of financing equity which is 30%. The $\frac{D}{V}$ indicates the percentage of financing debt, which is 70%. The required rate of return on equity, R_e, is calculated at 16%. The cost of financing debt which is indicated as R_d is equal to 3.41 % for the biofuels production in Turkey. It is assumed that borrowing loans will be possible from Islamic Development Bank and European Investment Bank (IDP and EIB) with an interest rate of 3.41%. Since all of the computations are based on TL, we must adjust the results with the inflation rate which is around 8.5% (price index difference when we converted USD to TL). When we include corporate taxes of 20%, (which is denoted as T_c) to our model, then the WACC for Turkish biofuels becomes 11%.

$$WACC = 0.30^{*}0.16 + 0.70^{*}((0.0342 + 0.085)^{*}(1 - 0.20)) = 11\% \quad (8)$$

In our DCF model, we use Central Bank of the Republic of Turkey`s discount rate use 9.25% to find out the NPV value. Our cash flow model considers every financial detail regarding the sugar beet based bioethanol investment in Turkey.

Using the Central Bank of the Republic of Turkey`s discount rate (CBDR) 9.25% for the same study of calculations may result in an NPV that is equal to -15,366,000,000 TL with nominal prices. Using the WACC method and the computed discount rate of 11% also gives a negative NPV that amounts to -13,571,000,000 TL. Since both calculations produce negative NPVs, one should consider that the WACC discount rate is greater than the CBDR, meaning that the Turkish beet sugar ethanol industry may become more costly than its rival competitors such as Brazil, USA and other biofuel producing countries.

Table 3. Discount Rates and NPV (million TL)

DR	6%	7%	8%	9%	10%	11%	12%	13%	14%
NPV	-19815	-18260	-16880	-15651	-14554	-13571	-12688	-11892	-11173

Discussion

For short-term investments, the main policy should be to avoid any large-scale implementation of biofuels until feedstock costs reduce at a significant rate. Germany and France, for instance, have political and cultural interests in their primary industry and their national policy is in favor of biodiesel and ethanol production. However, the high cost of subsidies is prompting some policy rethinking. After careful examination of the outcomes of discount rates that result in a negative NPV for Turkey, it is highly recommended by the researchers that Turkey should start reforming their biofuel production as Germany has done through enacting newly established rules and regulations for the Turkish ethanol market. With the enforcement of laws, up to an extent, Turkey should produce bioethanol from sugar beets. It is worth noting that in Germany producing bioethanol from sugar beets also has negative NPV returns. There is a consensus in Germany to proceed with bioethanol production due to the expectations of technological improvements and lower costs in the future. A major reason for this policy is that future technological improvements and developments will bring major cost reductions to the production process. The technology required for fossil fuel production is subject consideration before taking any role in biofuel production in the Turkish market. There is also a need to investigate its future sustainability and viability. From the EU perspective, there is an urgent need to create energy mix for the security of our future energy supply. Considering this together with the energy dependency of the Turkish economy, one needs an alternative energy without any greenhouse gases. Turkey currently imports ethanol from abroad due to a lack of legislations. One must consider how to develop a promising bioethanol industry that adjusts to the speed of technological developments and that also satisfies the increasing demand for energy in Turkey. With the rapid economic growth over the last decade, Turkey has doubled its energy consumption in the transformation sector as well as in the industry.

Conclusion

This study simply describes how to estimate the WACC and the issues that need to be considered when doing so in the Turkish biofuel industry. The WACC returns show different results for different firms with various financial structures. Every firm should then choose its own discount rate in order to decide if their investment is viable and sustainable or whether it's worth it. The CBDR is based on the financial discount rate of the Turkish Economy and it is more appropriate to be used for industries other than the biofuel industry. The analyst will also want to find out from the organization's financial specialists which discount rate the organization uses for discounted cash flow analysis. Normally financial officers may use a higher discount rate for investments or decisions viewed as risky, and lower discount rates when expected returns from a proposed action is seen as less risky. The higher rate is viewed as a hedge against risk because it puts relatively more emphasis (weight) on near-term returns compared to distant future returns

As the economic conditions in Turkey are changing dynamically, as with inflation, economic growth, investments, interest rates, energy dependency and the balance of payments deficit, one should always take into consideration how to compute a new WACC for each investment and even for each industry.

This study is also based on the following assumptions that the price of sugar beets comes from the Turkish C-Type quota and it is around TL 80 which is indexed to the sugar beet price in the world market. The capacity of the plant is around 120,000,000 litter per annum. Using sugar beets as a major input in Turkey is expected to be 1.72 million ton per annum. The total investment cost has been calculated at 512 million TL with nominal prices. Taking all these figures into account, the NPV becomes negative with a calculated rate of 11% WACC. Therefore, having a negative NPV for the sugar beet bioethanol production in Turkey indicates that investments in the biofuel production in Turkey is not yet viable and sustainable when compared to Brazil's sugar cane base ethanol investments. This seems more realistic than the one used by MIT Energy Initiative for Cyprus' natural gas monetization with a rate of 8.25% ± 0.5. The large energy dependency of the Turkish economy negatively impacts the environment with high carbon dioxide emissions exceeding the greenhouse gas limit that is required by the Kyoto Protocol. Turkey should urgently consider moving to alternative energy sources. It is better to concentrate more on the bioethanol production and sugar beet production. Currently, Turkey does not have any proper costs and benefits balance, yet this does not mean that this current negative NPV for biofuel investment will stay forever.

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