On the EU–U.S. Biodiesel 'Splash & Dash' Controversy: Causes, Consequences and Policy Recommendations

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Updated: 23 October 2010

Selected Paper prepared for presentation at the Agricultural & Applied Economics Association 2010 AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

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The Economics of a Blender's Tax Credit versus a Tax Exemption: The Case of U.S. 'Splash & Dash' Biodiesel Exports to the European Union

Abstract

This paper shows that the effects of the U.S. blender's tax credit of $1/gallon and 'splash & dash' had minimal impacts on the EU biodiesel market. Reduced world oil prices and EU tax exemptions, increased rapeseed oil prices and market uncertainty are shown empirically to be the major contributors to reduced profitability of EU biodiesel production. Nevertheless, the EU imposed tariffs sometimes exceeding the tax credit in retaliation for the U.S. 'splash & dash' program. Instead, EU imports from the United States can be beneficial for EU taxpayers, fuel consumers as well as U.S. biodiesel producers.

Key words: 'splash & dash', biodiesel, blender's tax credit, tax exemption, trade, European Union, Germany, Unites States

JEL classification: F13, Q17, Q27, Q42

1. Introduction

Both the United States and the European Union have used biodiesel consumption subsidies. The EU subsidy is in the form of a tax exemption at the retail fuel pump (47.04 cents/liter in Germany in July of 2006 but is being reduced over time) while the U.S. consumption subsidy initiated in 2004 was a blender's tax credit of $1/gallon. However, the U.S. blender's tax credit was not extended after the end of 2009. Each policy has identical market effects in a closed economy: it raises the market price of biodiesel by the amount of the subsidy (de Gorter and Just 2008; 2009b). However, with international trade, only one country's policy can establish the world price of biodiesel (Kliauga, de Gorter and Just 2008; 2010). Because the EU tax exemption is higher than the U.S. tax credit, the world biodiesel price is set by market parameters in the European Union.[1] This paper shows how the EU biodiesel price is determined, including its link to world oil prices, and how it is affected by a tax exemption for biodiesel and a differential fuel tax on diesel *versus* gasoline. In this situation, the U.S. biodiesel price is equal to the EU price less transportation costs (Figure 1). This means the U.S. blender's tax credit acts instead as a biodiesel production subsidy.[2] If the reverse was true and the world market price was established by the U.S. tax credit, then the EU tax exemption would subsidize fuel (diesel and biodiesel) consumption instead and would not benefit EU biodiesel producers directly.[3]

Because of rising oil prices, a high fuel tax exemption for biodiesel and modest rapeseed oil prices, EU biodiesel production capacity skyrocketed from 2004 to 2008 but actual production stagnated at about half of capacity after 2007 (see Figure 2 for Germany).[4,5] Meanwhile, imports from the United States increased substantially (Figure 3) as each gallon of domestically produced or imported biodiesel that was blended with oil-based diesel was eligible for this subsidy (regardless of amount - a typical blend was a 'splash' of 0.1 percent diesel and 99.9 percent biodiesel).[6] The resulting blend was then exported ('dashed') to the European Union.[7]

As a consequence of declining profitability of EU biodiesel sector (reflected by stagnation in production and excess capacity) and soaring imports from the United States, the EU biodiesel producers asked the European Commission for an investigation into biodiesel imports from the United States. They argued that the U.S. 'splash & dash' program "disrupted EU profit margins and put most of them [producers] out of business" (Voegele 2008). The European Commission (EC) initiated countervailing and antidumping investigation on June 13, 2008. The EC found material injury and in March 2009 implemented provisional anti-dumping and countervailing duties on biodiesel imports from the United States. The provisional duties were transformed into five year duties on July 7, 2009, and the countervailing component is approximately equal to about the U.S. blender's tax credit of $1/gallon (Official Journal of the European Union 2009b).[8]

This paper shows that the U.S. 'splash & dash' program had a minimal impact on the reduced profitability of EU biodiesel producers. The only way U.S. exports could affect the EU biodiesel price is twofold: (1) the *change* in U.S. biodiesel exports due to blender's tax credit reduces world oil prices, or (2) the EU mandate would otherwise be binding and enhanced U.S. exports due to a blender's tax credit increased supplies to EU biodiesel market such that the price premium of a mandate was eliminated (or decreased). We show that the effect of additional (world) biodiesel production due to 'splash & dash' on world oil prices is minimal. In Germany, the biodiesel tax exemption was determining the market price until June 2008. In July 2008, the

German biodiesel-specific blend mandate of 4.4 percent started to bind because of the reduction in the tax exemption and falling diesel prices. Beginning January 2009, the market price of biodiesel in Germany is seemingly being established by the 'overall' biofuel mandate. Although U.S. exports under 'splash & dash' plummeted after the tariff, we provide evidence that the most important reasons for reduced EU biodiesel production profitability were reduced world oil prices and EU tax exemptions, and increasing price of the feedstock (rapeseed oil). Market uncertainty has also negatively affected the production levels. This is confirmed with data showing that excess EU biodiesel production capacity is still high, even 19 months after the tariff was imposed in March 2009 and with the German tax exemption increasing in October 2009.

U.S. producers were 'double-dipping' as they benefited from both the U.S. blender's tax credit and the high biodiesel price due to EU tax exemption (although EU production was eligible too, it faced two-way transportation costs). EU imports surged in the second quarter of 2007. Previously, the European Union was by far the biggest producer of biodiesel in the world with much higher production capacity relative to other countries. In mid-2007, however, numerous biodiesel production plants emerged in the United States, Indonesia and Malaysia. Moreover, before October of 2008, both domestic and imported biodiesel was eligible for the U.S. blender's tax credit. The above together with a significant increase in the world oil price in the first half of 2008 (which translated into an increase in EU biodiesel market prices) contributed to the expansion of the 'splash & dash' biodiesel trade.

The remainder of the paper is organized as follows. The next section analyzes the economics of a tax exemption and blender's tax credit in an open economy. In particular, we show how the world market price of biodiesel is determined, which country establishes it, and the effects of the other countries' policies. In Section 3, we theoretically model the impact of the 'splash & dash' on welfare in the European Union and the United States. Section 4 uses empirical data on the 'splash & dash' policy for Germany to illustrate its impacts on biodiesel market price. The final section provides some concluding remarks.

2. The determination of the world market price of biodiesel

In a closed economy, a blender's tax credit has the same effect as a fuel tax exemption – both constitute a biodiesel consumption subsidy that raises the market price of biodiesel and hence constitutes an unfair advantage over diesel (oil) production (de Gorter and Just 2008, 2009a). Hence, both tax credits and tax exemptions in this situation are by themselves actionable subsidies in domestic countervailing duty law or WTO law from the point of view of producers of diesel or oil only.

But the situation gets more complicated with international trade. Do both tax exemptions or tax credits at the same time increase the market price of biodiesel? Analysis in Kliauga, de Gorter and Just (2008; 2010) shows that only one country's policy and market situation determines the world biofuel price. So what factors determine which country establishes the world market price of a biofuel? The world market price of biodiesel is either (1) linked to the diesel (oil) price by a tax exemption or tax credit in the country with a combination of the highest consumer price paid for diesel and the *lowest net tax* (the combination of the lowest fuel tax and highest biofuel tax exemption/tax credit) (Kliauga, de Gorter and Just 2008; 2010) or (2) is determined by a binding mandate if biodiesel price in the country is higher than under the case (1). Consistent with this theory, we show below that the world biodiesel prices have been established in the European Union; they have been higher than the U.S. market prices and so U.S. biodiesel prices follow EU prices (Figure 1).[9,10]

The EU fuel tax exemption for biodiesel

To determine the market price of biodiesel, assume biodiesel and diesel are perfect substitutes. Thus the price a consumer is willing to pay for a gallon of biodiesel equals the price of diesel adjusted for the lower energy content of biodiesel:

(1) $$P_B = \gamma P_D$$

where P_B is the price of biodiesel, P_D is the price of diesel, and γ is a number of miles traveled per gallon of biodiesel relative to gallon of diesel ($\gamma \approx 0.90$).

With a fuel excise tax on diesel *t*, the consumer's willingness to pay for biodiesel increases by less than the amount of the tax because of the lower energy content of biodiesel. It is given by:

(2) $$\gamma\left(P_D + t\right)$$

In the European Union, a lower excise tax is placed on biodiesel relative to regular diesel (i.e., a consumption tax exemption t_e is provided, and has often been equal to the diesel fuel tax). Therefore, the EU fuel blenders earn revenues per liter of biodiesel of:

(3) $$P_B + t - t_e$$

Market equilibrium is established when:

$$P_B + t - t_e = \gamma\left(P_D + t\right)$$

Solving for P_B, the biodiesel market price, we obtain:

(4) $$P_B = \gamma P_D - (1-\gamma)t + t_e$$

Equation (4) identifies four principal determinants of the EU biodiesel price: the world oil market price reflected by the diesel market price, miles traveled per gallon of biodiesel relative to diesel, the fuel excise tax and the biodiesel tax exemption. Implicitly embedded in (4) is also a fifth determinant − indirect subsidization of diesel which results in a higher biodiesel price in Europe (by means of a lower *volumetric tax* relative to gasoline). This happens because in most EU countries diesel tax is lower than gasoline tax. It means that if diesel and gasoline were taxed on an energy-content basis (instead of volumetrically, as it is the case now), then the diesel tax would increase and by equation (4), the biodiesel market price would decline.[11]

Because of the tax exemption, EU fuel blenders are able to pay more for biodiesel. Competing blenders of biodiesel and diesel will bid up the price of biodiesel until in theory it is above the market price of diesel (according to equation (4)) by the full amount of the tax exemption.

The net subsidy or the effective rate of biodiesel support in the European Union (which U.S. producers can equally benefit from) is given by the term $-(1-\gamma)t+t_e$, where the first part is a penalty due to volumetric taxation of biodiesel where the lower mileage per gallon of biodiesel relative to diesel is not taken into account. For instance, the net subsidy to biodiesel industry in Germany decreased stepwise from 0.419 Euro/l in 2005 to 0.220 Euro/l in 2009.

Now assume there are no transportation costs, no blender's tax credit in the United States and that the tax exemption is used only in the European Union. In this situation, the European Union benefits from the net subsidy but so do U.S. producers provided it exports biodiesel to the European Union.

But what if the opposite was the case: there is no tax exemption in the EU and the U.S. has a blender's tax credit. In this hypothetical situation, the net biodiesel subsidy in the United States (calculated using the U.S. fuel tax rates and the blender's tax credit) ranged from 0.181 to 0.209 Euro/l between 2005 and 2009.[12] Hence, over most of the time period, the net subsidy to German producers was twice as high as in the United States.

In reality, however, the U.S. biodiesel producers could take advantage of both the U.S. and the EU net subsidy, but only a little amount of EU biodiesel took advantage of the U.S. subsidy as apparently it was not profitable for much of the time period for EU producers to ship biodiesel to the United States and then back to Europe

Mandate

In the empirical section of the paper below, we show that the EU tax exemption was binding (and determining the price of biodiesel) up to June 2008. From July 2008, the actual market price is above that predicted by equation (4). This suggests the EU mandate was binding and the EU tax exemption did not determine biodiesel prices. The recent literature analyzing economic impacts of two major biofuel policies – a blender's tax credit and consumption/blend mandate has found that the market price of a biofuel is always determined by only one of them, never both (de Gorter and Just, 2007; 2009a,b).[13] For an exposition on how the price of a biofuel is determined under a mandate see de Gorter and Just (2007, 2009a) and for an excellent application to the French biodiesel mandate and tax exemption see Doumax (2010). With a binding mandate in place, prices of biodiesel are delinked from the oil prices and so if imports are high enough, they can decrease the price premium, thus affecting price of biodiesel.[14]

Does it matter if the other country has a tax credit vs a tax exemption?

So far we showed that the European Union determined the world biodiesel market price and also that the U.S. tax credit by itself would result in a much lower net subsidy and, therefore, a lower price for biofuel. In reality, there is international trade and markets are linked. Many countries apply either a tax exemption or tax credit. This poses a question as to what are the effects of tax credits or tax exemptions in the countries outside the European Union that do not determine the world price.

Either policy (a tax exemption or a tax credit), in the price-determining country is an actionable subsidy by itself, from the point of view of oil producers (but not for biofuel producers, as biodiesel producers gain worldwide). It is because either the tax exemption or the tax credit (depending on which determines the world market price) increases the market price of biodiesel and hence its production above a level that would have otherwise existed. Therefore, oil production may be crowded out due to these policies.

Assuming a two-country world, the question now becomes whether a tax credit (tax exemption) in the other country is also necessarily an actionable subsidy. Not always, as the table below summarizes. The reason is that once the world market price of biodiesel is established by one country (A), a tax credit or a tax exemption in the other country (B) cannot affect it, but acts as a production subsidy in the case of a tax credit and fuel consumption subsidy with a tax exemption. Therefore, if country B has a tax credit, then it is an actionable subsidy, but a tax exemption is not (oil producers can even benefit from it because as fuel consumption increases so does consumption of diesel). Furthermore, if country B has a tax credit (as was the case with the United States and the 'splash & dash' program), it expands biodiesel exports as a result of increased biodiesel production and imports from third countries that are 'splashed' and then 'dashed' to country A (the European Union).

Is country B's policy actionable?

	Country B's policy **(receive same biodiesel price established by country A)**	
Price established by country A by: **(policy by itself always actionable for oil producers)**	tax credit	tax exemption
tax exemption	✓	×
tax credit	✓	×

Note: ✓- policy in country B is actionable by oil producers, × - policy in country B is not actionable

The above table also proves useful if one seeks to determine what the impact of various combinations of biofuel policies would be, conditional on which country (and policy in that country) determines the biodiesel price. For example, if the United States determined the world biodiesel price (country A in this case) through a tax exemption, then the EU tax exemption would subsidize fuel consumption and so have little or no effect on U.S. biodiesel prices. On the other hand, if the European Union had a tax credit, it would subsidize biodiesel production.

One clear implication is that the entire 'splash & dash' controversy would not exist if the European Union switched their tax exemption to a blender's tax credit or the United States switched their tax credit to a tax exemption. In this way, no country can 'double dip'.

Tax exemptions or tax credits are not additive: the market price of a biofuel is not determined by the sum of each country's tax exemption or credit.[15] The only impact on the biofuel price in countries that do not establish the market price of biofuels is indirect insofar as the change in biodiesel production or consumption affects world diesel (oil prices) and hence the biodiesel market price in the European Union where it is 'established'.[16] The fact that a combination of the consumer diesel price paid, fuel tax and biodiesel tax exemption in the European Union established the world market price of biodiesel occurred even though the prices of biodiesel, biodiesel feedstock and oil (diesel) are linked to each other within a country and across countries through international trade.

Another example of the complexity of a tax credit versus tax exemption is Canada that switched its tax exemption to a biofuels producer tax credit in April 2008 (Auld 2008). Because Canada is too small to influence either the world market price of ethanol, corn or oil, the former tax exemption in Canada subsidized domestic fuel consumption (ethanol and gasoline). But the new Canadian biofuels producer credit program subsidizes biofuels production instead (and Canada has exported all domestic biodiesel production, taking advantage not only of the domestic production subsidy but also of both the high market price established by the EU tax exemption and the U.S. blender's tax credit). Until the United States closed the 'splash & dash' loophole, Canada had therefore 'triple dipped': benefiting from its own biofuels producer tax credit (available only for domestic production), the U.S. blender's tax credit (available to U.S. production and U.S. imports), and a high EU biodiesel price due to EU tax exemptions. Furthermore, Canada has now established a mandate; this will tax gasoline to pay for the higher price of ethanol established in world markets while domestic biofuels producers will be unaffected.

3. The welfare economics of 'splash & dash'

The market effects of the U.S. 'splash & dash' program are shown in Figure 4. To keep the analysis tractable, we assume no transportation costs. The world price of biodiesel P_B^{EU} is determined in the European Union by the tax exemption (see equation (4)). The price is assumed to be unaffected by *changes* in EU biodiesel imports due to U.S. policy.[17] Without loss of generality, the U.S. biodiesel supply curve S^{US} is assumed to be inclusive of foreign biodiesel import supply.

If there was no 'splash & dash', a U.S. (and foreign) producer has to sell directly to either the U.S. or EU market. If biodiesel is blended with regular diesel in the United States, then the mixture has to be consumed domestically and cannot be exported to the European Union to take advantage of a higher market price generated by the EU tax exemption. Because biodiesel prices are higher in the European Union, one would expect all U.S. biodiesel production to be exported. Nonetheless, we observe domestic consumption of biodiesel in the United States. This is because, among other reasons, some U.S. states have their own biodiesel consumption mandates, there are huge variations in transportation costs for export, and a portion of domestic biodiesel production is also used directly in biodiesel transport. Therefore, in the 1st panel of Figure 4, we model domestic demand for biodiesel in the United States.

At the prevailing world biodiesel price P_B^{EU} , the quantity Q^{US}- C^{US} is exported to the European Union.[18] Total biodiesel supply in the European Union is the horizontal sum of the EU supply curve S^{EU} and the U.S. excess supply curve ES^{US}. At price P_B^{EU} , total quantity of biodiesel available in the EU market is Q^{EU}+M^{EU}, where M^{EU} denotes imports from the United States.

Under the 'splash & dash' scenario, both domestic U.S. biodiesel and biodiesel imported into the United States is first blended with regular diesel to be eligible for the $1/gallon blender's tax credit and then a portion is exported to the European Union. The U.S. biodiesel supply curve shifts down by the amount of the per unit blender's tax credit t_c. Because the world biodiesel price does not change, domestic U.S. biodiesel consumption remains unchanged and so all additional U.S. biodiesel production (and imports) due to the production subsidy effect of 'splash & dash' is exported. Total EU biodiesel supply is Q^{EU}+$M^{EU\prime}$ but EU production of biodiesel and total EU consumption of biodiesel and diesel fuel is unaffected.

The welfare effects of 'splash & dash' are depicted in Figure 5. To simplify the exposition, we assume there is no demand for biodiesel in the United States, i.e., all U.S. biodiesel production is exported to the European Union. Under the scenario of no 'splash & dash' program and free trade, the total quantity of biodiesel available in the EU market is $Q^{EU}+Q_0^{US}$.

Now, assume no 'splash & dash' program and U.S. biodiesel is excluded from the EU market (say due to a prohibitive tariff like the current EU tariff equal to about the U.S. tax credit of $1/gallon.). In this case, the EU biodiesel market price would have to increase to P_1 to generate an equivalent level of EU biodiesel production to achieve EU biodiesel consumption prior to the prohibitive tariff (and without a U.S. tax credit). The EU tax exemption would have to increase and so EU taxpayers would have to pay area a+b in the 2nd panel of Figure 5 to achieve the same level of consumption as with free trade and no U.S. policy. The current EU tax exemption is not enough for this to happen – the mandate would have to kick in (as it has at the beginning of 2009).[19]

On the other hand, a prohibitive tariff would cost U.S. taxpayers area g+h in the1st panel of Figure 5 in order to raise biodiesel production from an autarky level (associated with price P_A^{US}) to the free trade level.[20] Therefore, the sum of areas a+b and g+h in Figure 5 represents gains to both countries from U.S. - EU biodiesel trade *without the U.S. tax credit*.

Suppose the United States provides a blender's tax credit to achieve a desired level of biodiesel consumption (production and imports) or 'mandate' Q_1^{US} (yet to be enforced) where exports are not counted towards the mandate.[21,22] Up until October of 2008, all biodiesel (domestic and imported) was eligible for the U.S. tax credit provided pure biodiesel was blended with a 'splash' of diesel in the United States. For convenience, in Figure 5 the new U.S. biodiesel production with the blender's tax credit in place exactly matches the production mandate. This has actually been the case in 2009 (where the U.S. mandate was not enforced through RINs, unlike U.S. ethanol). Assuming that all tax credit-induced biodiesel production in the United States ($Q_1^{US}-Q_0^{US}$) is exported, the total quantity of biodiesel available in the European Union is $Q^{EU} + Q_1^{US}$. With a blender's tax credit in place, U.S. taxpayers lose area *e+f*, the U.S. and foreign biodiesel producers (except for EU producers) gain *e,* while EU taxpayers lose about twice that in the form of tax revenues foregone (because the EU tax exemption is about twice the U.S. blender's tax credit). EU biodiesel producers and fuel consumers are unaffected. Moreover, the U.S 'splash & dash' program helps to achieve the EU renewable fuels target without taxing EU fuel consumers or taxpayers.[23]

On the other hand, in a hypothetical situation where biodiesel exports from the U.S. do count towards both mandates, then the question arises as to what are the welfare gains for both countries? The U.S. values its domestic mandate by $\left(P_B^{EU} + t_c\right) \times Q_1^{US}$. If all U.S. mandated biodiesel were exported to the European Union its societal value there would be $S^{EU}\left(Q_1^{US}\right) \times Q_1^{US}$, where the first term represents the biodiesel price that would have to prevail on the EU market in order to generate production of Q_1^{US} gallons of biodiesel. Therefore, the total societal gains of counting the same biodiesel towards two mandates are $\left(P_B^{EU} + t_c\right) \times Q_1^{US} + S^{EU}\left(Q_1^{US}\right) \times Q_1^{US}$.

If 'splash & dash' exports are eliminated by means of a prohibitive tariff, but European biodiesel consumption were to stay at $Q^{EU} + Q_1^{US}$ (i.e., the level associated with a 'splash & dash' scenario), then the EU tax exemption would have to increase to generate biodiesel price of P_2, in order to achieve consumption levels with 'splash & dash'. The EU taxpayers would have to spend *a+b+c+d* compared to the 'splash & dash' scenario. This would make the European Union worse off relative to a situation of allowing U.S. exports to count towards the target. Since area *a+b* represents gains to the European Union from biodiesel trade (with no biodiesel policy in the United States), area *c+d* must then be gains (i.e., saved EU fiscal loss) attributable to the U.S. 'splash & dash' program. The total welfare gains associated with 'splash & dash' only are *c+d–f*. Because, in this situation, there is no trade in biodiesel, the total societal value of U.S. biodiesel is $\left(P_B^{EU} + t_c\right) \times Q_1^{US}$.

4. Empirical analysis of factors affecting EU biodiesel prices

We now provide empirical evidence of the four major drivers of biodiesel market prices and hence EU industry profitability: oil prices, the EU fuel tax exemption, rapeseed prices, and market uncertainty. We show imports from the United States had little effect on EU market prices (if any). For availability reasons, data for Germany are used. The key indicator of lack of profitability is excess production capacity (Figure 2). Production capacity spiked in 2007 and excess capacity has been around 50 percent since. Construction of new production capacities, well beyond the point of actual biodiesel production, was initially incentivized by a system of generous biodiesel tax exemptions, low rapeseed oil prices, rising oil prices and so expectations of investors were very high about the long-run profitability of the sector.

Biodiesel market prices in Germany closely follow the development of diesel (oil) prices. The latter started to soar in the second half of 2007, peaked in June 2008 and plummeted shortly afterwards. Currently, the diesel prices are at their pre-2007 levels (Figure 1). As biodiesel prices started to decrease sharply after July 2008, profitability of EU biodiesel production deteriorated accordingly which is reflected in the high excess production capacity.

The changes in the biodiesel tax exemption in Germany are positively correlated with profitability of the biodiesel sector. The German tax exemption started to decline in August of 2006 and currently (as of September 2010) amounts to 0.29 Euro/liter – a drop of 0.18 Euro/liter relative to what it used to be prior to August of 2006 (Figure 1). The process of the tax exemption reduction is scheduled to end up in 2012 when the biodiesel excise tax will be on par with that of diesel (Biodiesel magazine 2009).

Rapeseed oil is the predominant feedstock for biodiesel production in the European Union. The gap between biodiesel and rapeseed oil price narrowed significantly between July of 2007 and April of 2008, adversely affecting profitability of biodiesel production (Figure 6). This period also coincides with the peak in excess biodiesel production capacity in Germany (Figure 2). Therefore, soaring biodiesel imports from the United States, depicted in Figure 3, cannot be blamed as a major cause of low profits in the EU biodiesel sector. This is because the biodiesel price did not decline with imports. Interestingly, biodiesel prices show a positive and significant correlation with biodiesel imports from the United State (Figure 7). Busse et al. (2010) come to a similar conclusion, based on an econometric analysis: "while the subsidized U.S. B99 ['splash & dash'] imports certainly reflect a challenge for German biodiesel producers, they appear not to have a negative impact on the price developments and integration in the EU market."

Uncertainty in the EU biodiesel market has been yet another factor of the sector's problems. Huge production capacities were built up on the assumption that tax exemptions will not change. However, later the German government decided that these will be reduced gradually so as to finally level the playing field for regular diesel and biodiesel. Another example of uncertainty is an abrupt decrease in the announced overall biofuel mandate discussed below.

Now that we have determined what factors have affected the development of the EU (German) biodiesel prices, we analyze which biofuel policy (tax exemption or blend mandate) have historically established the market prices in Germany. Figure 8 presents the difference between actual and predicted biodiesel price on the one hand and the difference between German and U.S. biodiesel price on the other. Relevant events happening in the biodiesel market between 2005 and 2010 are labeled. Before the imposition of tariffs on U.S. biodiesel exports, the difference between the biodiesel market price in Germany and the United States was equal to transportation and transaction costs. They averaged 0.15 Euro/liter in the period of November 2006 to June 2008.[24] After the tariff was imposed, this difference increased to 0.25 Euro/liter. Subtracting the former figure from the latter, we should approximately get the applied tariff rate. However, the difference of 0.10 Euro/per liter coincides with the simple average of the current anti-dumping tariffs of 0.11 Euro/liter (Official Journal of the European Union 2009a), but seems not to be reflecting the average countervailing duty of 0.19 Euro/l (Official Journal of the European Union 2009b). This perhaps can be explained by other countries increasing exports directly to the European Union, perhaps even Argentina which implicitly subsidizes biodiesel exports with differential export taxes.

Close examination of Figure 8 reveals which biofuel policy determined the biodiesel price in Germany. If the difference between actual observed market prices and predicted biodiesel prices (as per equation (4)) is around zero, then the market price is determined by the tax exemption. A positive difference indicates a binding mandate. As a biodiesel mandate was absent prior to 2007, the biodiesel price must have been determined by a tax exemption. From 2007 to June 2008, the difference between actual and predicted biodiesel prices oscillates around zero suggesting that a tax exemption is still binding (and the 4.4 percent blend mandate imposed in January 2007 is not a determining factor).

Diesel prices plunged after July 2008 making the mandate bind. This is also supported by a significantly positive difference between actual and predicted biodiesel prices after July 2008. In 2009 the biodiesel price was still determined by a mandate. But why did the tax exemption not bind again, given that diesel prices were comparable to those of the pre-2007 period? The reason is that since 2009, an 'overall' biofuel mandate is pursued.[25] As a result, the actual share of biodiesel has been higher than the specific biodiesel blend mandate. The rational for this comes from the fact that fuel distributors are free to choose which type of biofuel (ethanol or biodiesel) they use to fill the gap between the fuel specific mandates and the overall mandates. However, since the mineral oil industry prefers biodiesel over ethanol, the majority of the volume consists of biodiesel (USDA 2009).

Our findings about which policy determines the biodiesel price in Germany can be cross-checked by comparing the observed shares of biodiesel with the blend mandate. The idea is that in the period when a tax exemption determines the price, the share of biodiesel should exceed the blend mandate. If a biodiesel specific mandate is binding, the actual biodiesel share should be close to the required blend. Finally, in the case that the overall mandate is binding, the actual biodiesel share is expected to exceed the specific mandate because of reasons explained in the previous paragraph.

We test our findings on the data for January 2007 to May 2010.[26] The actual share of biodiesel in diesel fuel is presented in Figure 9.[27] Consistent with our hypothesis, the actual biodiesel share in the period of January 2007 to mid-2008 is well above the minimally required 4.4 energy percent. The only inconsistency of the theoretical predictions and actual data occurs in the second half of 2008. Instead of fluctuating around the minimum biodiesel blend, the actual share is above it. We attribute this anomaly to market disequilibrium and expectations of market agents. In January 2009 the share stabilizes and is driven by the overall mandate to which biodiesel contributes most.

Figure 9 also documents the effects of a binding mandate. Prior to 2009, when no overall biofuel mandate was in place, the share of biofuels was mostly affected by the development in the biodiesel market. As soon as the overall binding mandate kicked in, the total share of biofuels stabilized at the level dictated by it. In Figure 9, we have superimposed the level of the originally announced (6.25 and 6.75 percent for 2009 and 2010, respectively) and the actual overall mandate in Germany (5.25 and 6.25 percent for 2009 and 2010, respectively). The actual biofuels share oscillates about the originally announced value in 2009 but shifts to the new blend level in 2010. This is a good illustration of the role of expectations in biofuel markets in Germany. The decision to reduce the blend came in October 2008 when all rapeseed was already harvested and contracts for the next year signed. This explains why the market did not respond to the change of the policy. However, during 2009 all segments of the biodiesel production chain could adjust their production plans so as to comply with the new blend mandate.

Finally, in Figure 10, we present a hypothetical situation under which there would be no U.S. biodiesel consumed in Germany over the period analyzed. The hypothetical share does not differ much from the actual share of biodiesel and from January of 2009 to present, the two are identical (due to insignificant imports from the U.S. relative to German domestic biodiesel consumption). This also suggests that the U.S. imports did not have a significant impact on the German biodiesel market.

The Situation in the United States

Both the U.S. and EU biodiesel sectors have faced the same challenges since 2007: excess production capacity and low profits. This coincides with the period of soaring biodiesel prices (Figure 1). The notable decrease in the world biodiesel price is reflected in the drop of biodiesel production and capacities in Germany (Figure 2) and the United States (Figure 11) in 2009 and 2010, relative to 2008 (although the decrease in U.S. production capacity is not as apparent as it is in the European Union). Despite large domestic production capacity, the U.S. biodiesel producers/blenders did not fully take advantage of producing biodiesel domestically and then exporting it to the European Union. This became significant especially in 2008 when biodiesel exports were almost as high as domestic production, but a considerable share of exports was biodiesel from outside the United States that benefited from ‘splash & dash’. In 2009 and 2010, the volume of exported biodiesel is smaller relative to 2008, yet represents a significant portion of domestic production. It is because in 2009 and most of 2010 the U.S. biodiesel consumption mandate is has not been enforced and so producers have sold biodiesel abroad at higher prices.

So what has happened after the EU import tariff was imposed? First, imports of biodiesel to the United States have plunged as importers are not allowed any longer to import and re-export biodiesel through the United States because they cannot claim a tax credit in this situation. Second, U.S. biodiesel exports have decreased significantly to the EU market because of the import tariff that reduces profits (Figure 12). However, even after 19 months since the imposition of the EU biodiesel tariffs, we have not seen a significant increase in profitability, production and biodiesel market prices in the European Union. This poses a question whether the ‘splash & dash’ program was indeed that harmful as claimed by the EU biodiesel sector. As long as a tax exemption is binding (i.e., determining the world price), then U.S. imports cannot have a negative impact on EU prices unless the *change* in exports affects world oil prices. This might be possible only if the biodiesel price were determined by a binding mandate; in this case biodiesel imports could lower the price premium of the mandate compared to that if only the tax exemption was binding. However, this biodiesel price premium above that if the biodiesel price was determined by the tax exemption may have been quite low. Besides, as we have shown, the German biodiesel mandate started to bind only after the peak of ‘splash & dash’ imports.

As of January 1, 2010, the U.S. biodiesel blender’s tax credit has expired which is reflected in a noticeable drop of U.S. biodiesel production in January 2010 (Figure 12). This drop was caused by an instantaneous plunge in U.S. producers’ prices that have been equal to the sum of the U.S.

biodiesel market price (U.S. Gulf) and the $1/gallon blender's tax credit (Figure 13). U.S. biodiesel producers now receive only the market biodiesel price which is still significantly higher than the predicted price. This reflects that world market prices are still influencing the U.S. market. There is no evidence the U.S. mandate is binding yet. It is because the U.S. market price is still possibly linked to the EU price through U.S. trade in biodiesel with other countries (e.g., Canada).

5. Concluding remarks

In response to the U.S. 'splash & dash' policy, the European Union imposed anti-dumping and countervailing import tariffs on biodiesel originating in the United States. The countervailing duty is about equal to the value of the U.S. blender's tax credit. Although both a tax credit and a tax exemption are biodiesel consumption subsidies by itself (in a closed economy world), it is true a U.S. blender's tax credit subsidizes world (including EU) biodiesel production if the tax exemption determines world prices. Had both countries had a tax exemption or a blender's tax credit, then the issue of a biodiesel production subsidy would not have arisen.

We conclude the controversy over the U.S. 'splash & dash' policy is much ado about nothing. The only way it could have affected the EU biodiesel price is if the change in U.S. exports due to the tax credit reduced world prices. This is implausible. The only other way is that U.S. exports could have reduced the price premium in the European Union due to a binding mandate. But the mandate was not made to bind in the European Union for much of the time period under investigation. This argument was not made in the investigation that established tariffs and this premium may have been quite small.

In 19 months after the imposition of the EU countervailing duties (ranging from 211 to 237 Euro/tonne, corresponding to 0.91 to 1.02 $/gallon) on U.S. biodiesel imports, we have not seen a significant increase in profitability, production and market prices in the European Union. This casts doubts on the claims of the European Biodiesel Board that the U.S. blender's tax credit with "splash & dash'? and accompanying surge in EU biodiesel imports causes reduced profitability for EU biodiesel producers by "driving down market prices and forcing EU producers to shut down production" (Dow Jones 2009)

The program could have been beneficial for EU taxpayers, fuel consumers as well as biodiesel producers in the United States. However, the U.S. taxpayer was worse off as blender's tax credit has cost billions of dollars.[28] In the meantime, the EU's tax exemption increased the (world) biodiesel market price above the price of oil-based diesel by almost the full amount of the exemption, benefiting biodiesel producers worldwide.[29]

We provide empirical evidence that the most important factors affecting reduced EU biodiesel production profitability were reduced world oil prices, decreasing EU tax exemptions, increasing rapeseed oil prices and market uncertainty.

To put our findings into perspective, note that the share of rapeseeds in Germany in total arable area was 12.3 percent in 2009 (based on data from Eurostat). Most of domestic rapeseeds were used for biodiesel production (together with imports from other EU countries). This considerable share of rapeseeds in Germany (and EU) just highlights another benefit of the 'splash & dash' program for the European Union: using foreign biodiesel (at the same price as domestic) leads to weaker competition for land which in turn alleviates the possible upward pressures on food prices in the European Union.

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Appendix: **Data sources**

German biodiesel tax exemption	Energiesteuergesetz (German Energy Tax Law)
U.S. biodiesel blender's tax credit	U.S. law; $1/gallon
Euro/Dollar exchange rate	The European Central Bank, http://www.ecb.int/stats/exchange/eurofxref/html/index.en.html
Diesel market price in Germany	EUROPEAN COMMISSION, Directorate General Energy and Transport http://ec.europa.eu/energy/observatory/oil/bulletin_en.htm
U.S. diesel market price	Energy Information Administration, http://tonto.eia.doe.gov/dnav/pet/pet_pri_spt_s1_d.htm
Diesel excise tax in Germany	EUROPEAN COMMISSION, Directorate General Energy and Transport http://ec.europa.eu/energy/observatory/oil/bulletin_en.htm
Price of biodiesel and rapeseed oil in Germany	UFOP-Marktinformationen, www.ufop.de
Biofuel conversion factors	http://www.fapri.missouri.edu/outreach/publications/2006/biofuelconversions.pdf
U.S. biodiesel price	The Bloomberg database
Trade in biodiesel between Germany (European Union) and the United States	United States International Trade Commission, http://dataweb.usitc.gov/ Imports of biodiesel from the U.S.: HS 3824.90.4000 Exports of biodiesel from the U.S.: HS 3824.90.4090
Biodiesel production and capacity in Germany	The European Biodiesel Board http://www.ebb-eu.org/
Price of soybean oil in the United States	Index Mundi http://www.indexmundi.com/commodities/?commodity=soybean-oil&months=60
Actual shares of biofuels in Germany	UFOP-Marktinformationen, www.ufop.de
U.S. biodiesel mandate	U.S. Energy Independence and Security Act of 2007

U.S. biodiesel production, consumption, exports, imports	Table 10.4: Biodiesel Overview, 2001-2009 http://www.eia.gov/emeu/aer/renew.html
U.S. biodiesel production capacity	2007 - 2009: National Biodiesel Board. 2010 (forecast): Federal Register / Vol. 75, No. 138 / Tuesday, July 20, 2010 / Proposed Rules

Figure 1: Prices of Biodiesel and Diesel in Germany and the United States (Euro/liter)

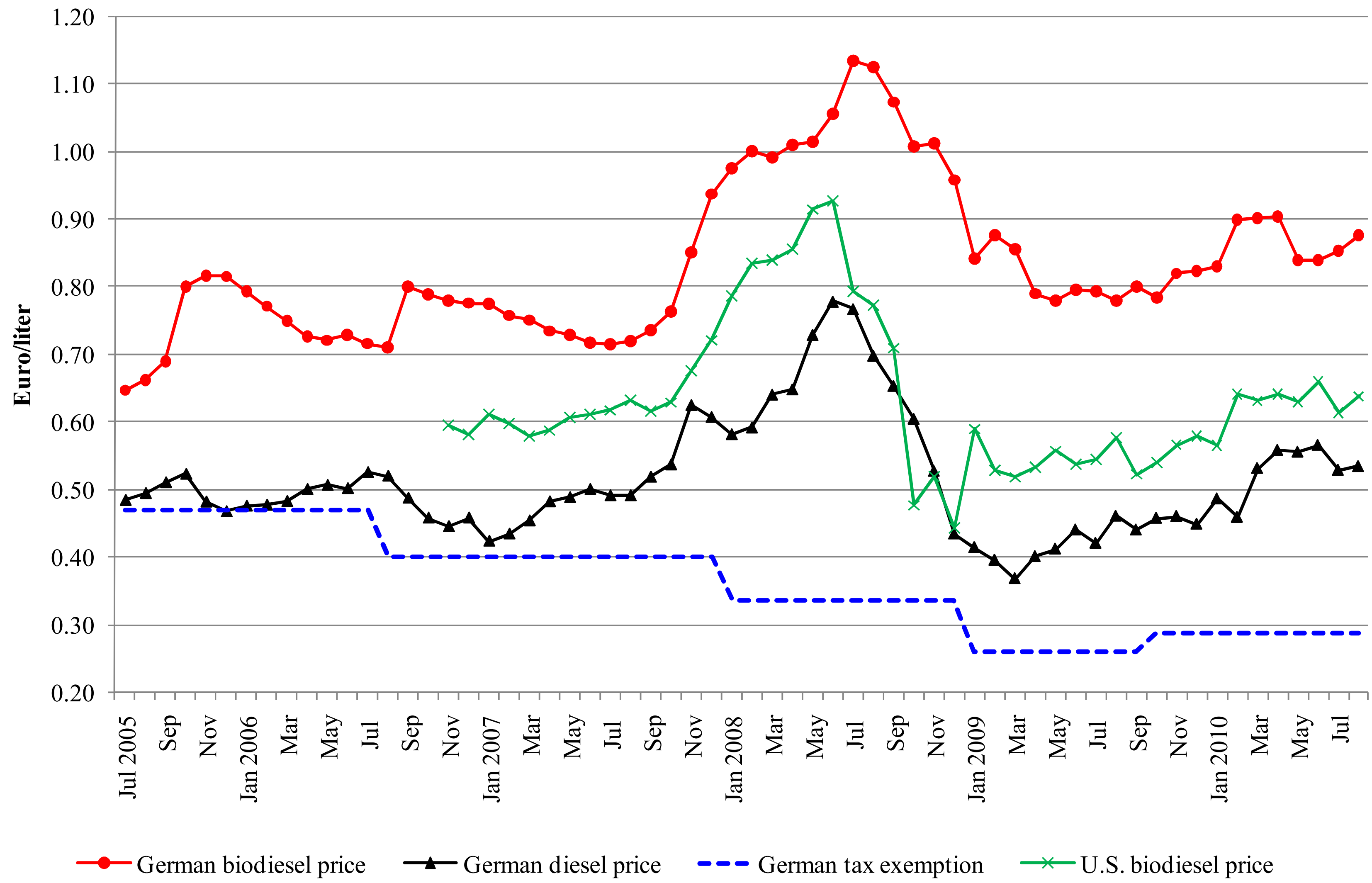


Figure 2: Actual Biodiesel Production and Production Capacity in Germany ('000 tonnes)

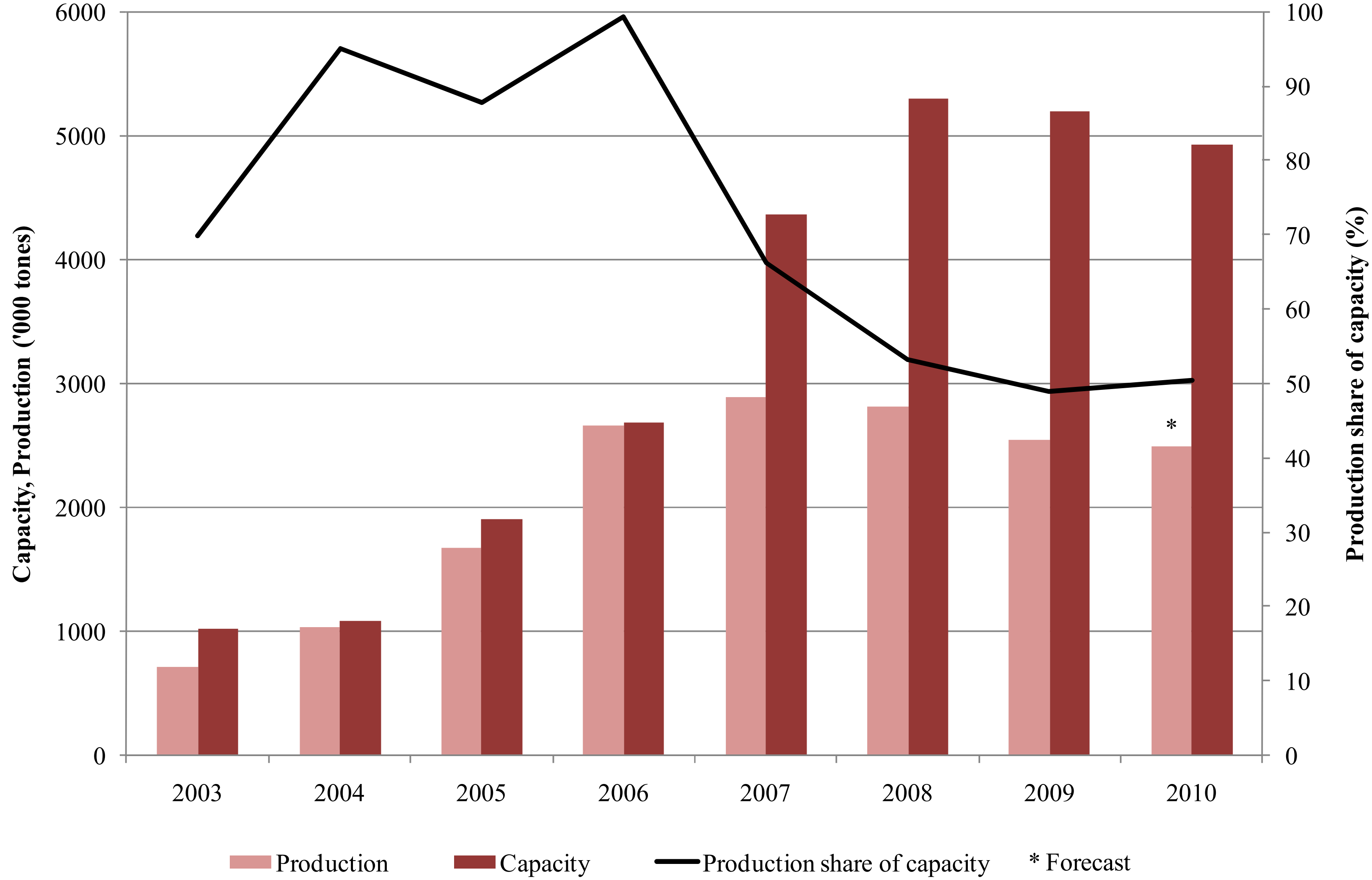


Figure 3: Net Imports of Biodiesel from the United States to Germany and the European Union (tonnes)

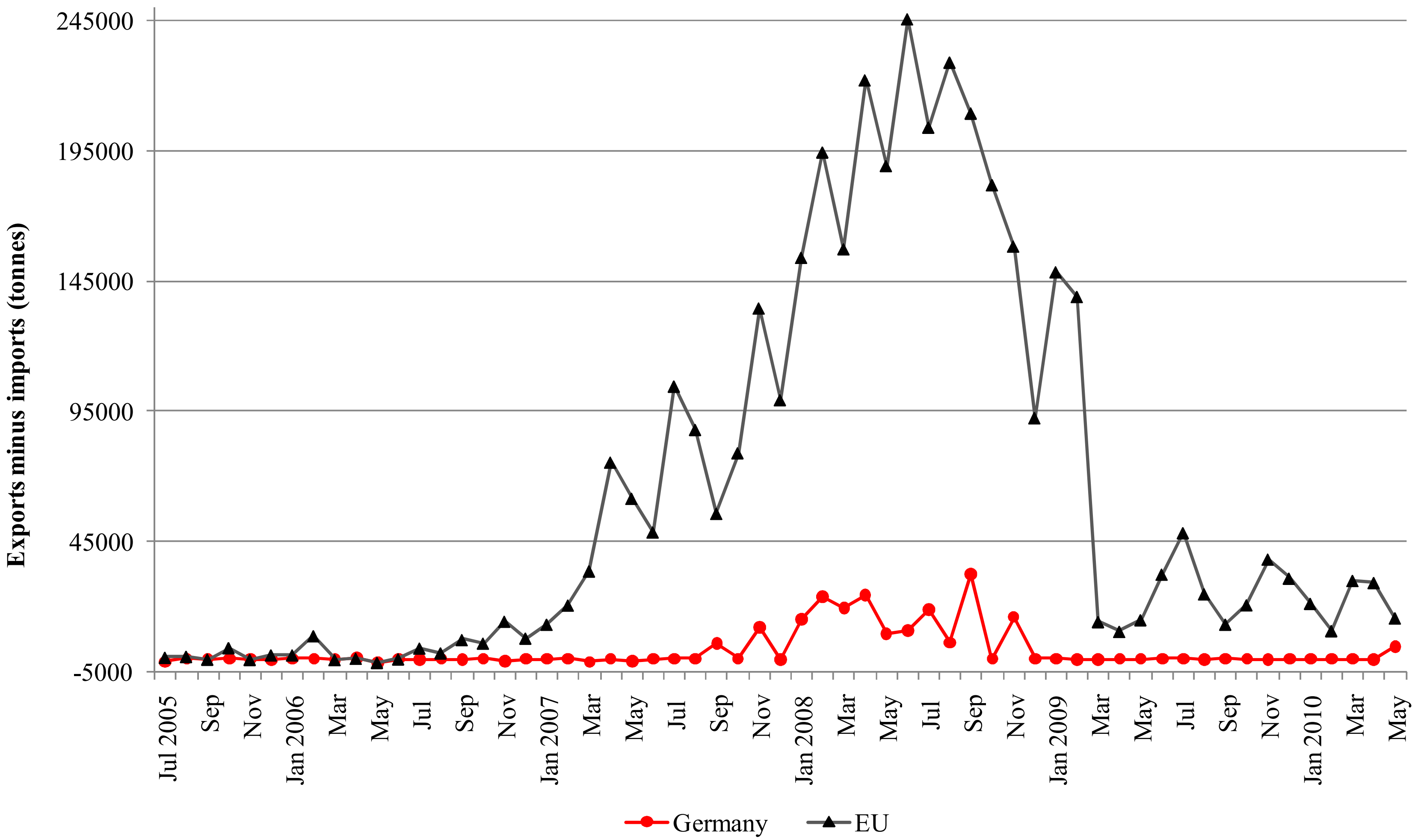


Figure 4: Market Effects of U.S. 'Splash & Dash'

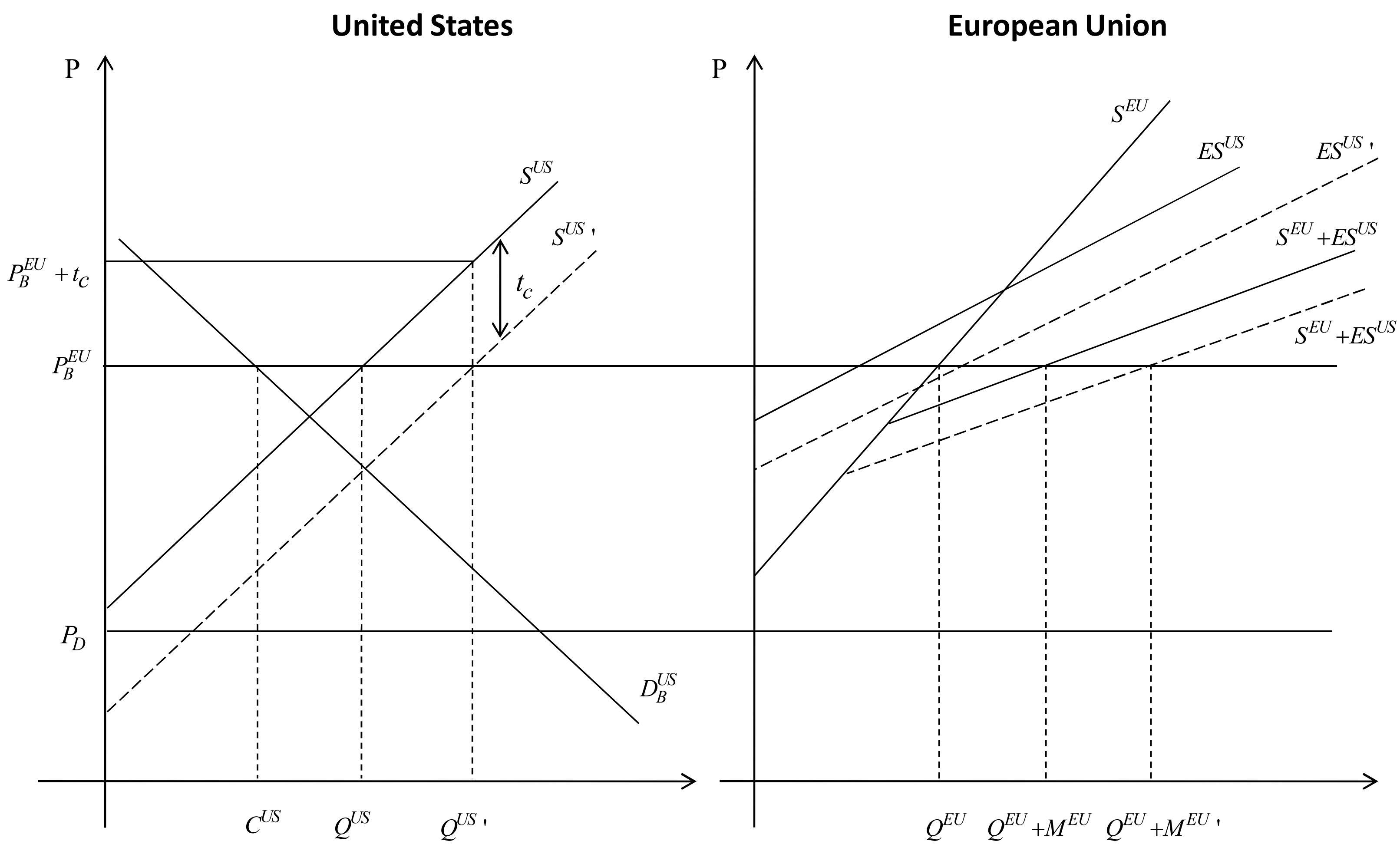


Figure 5: Welfare Effects of ‘Splash & Dash’

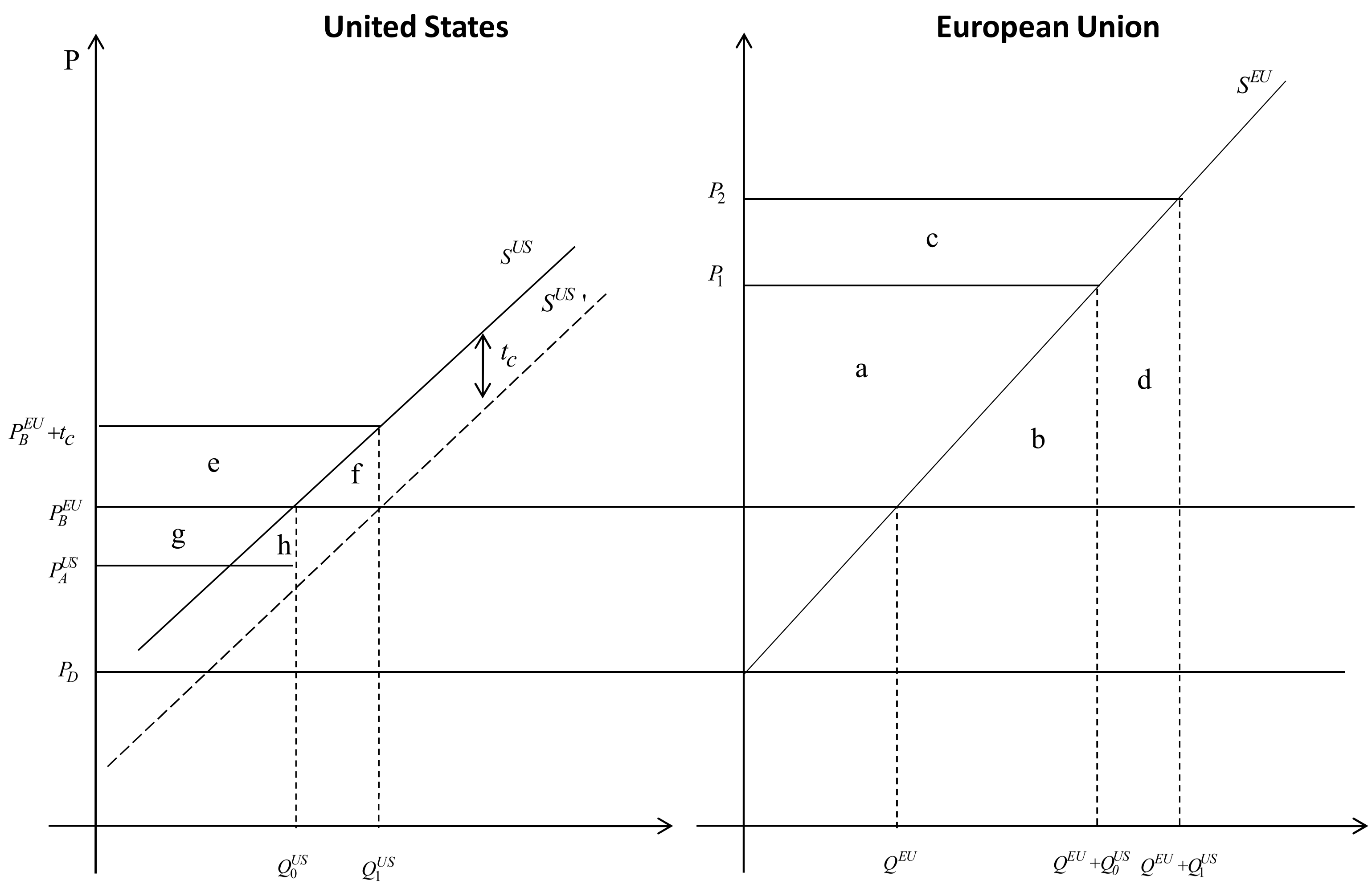


Figure 6: Biodiesel *vs* Rapeseed Oil Prices in Germany (Euro/liter)

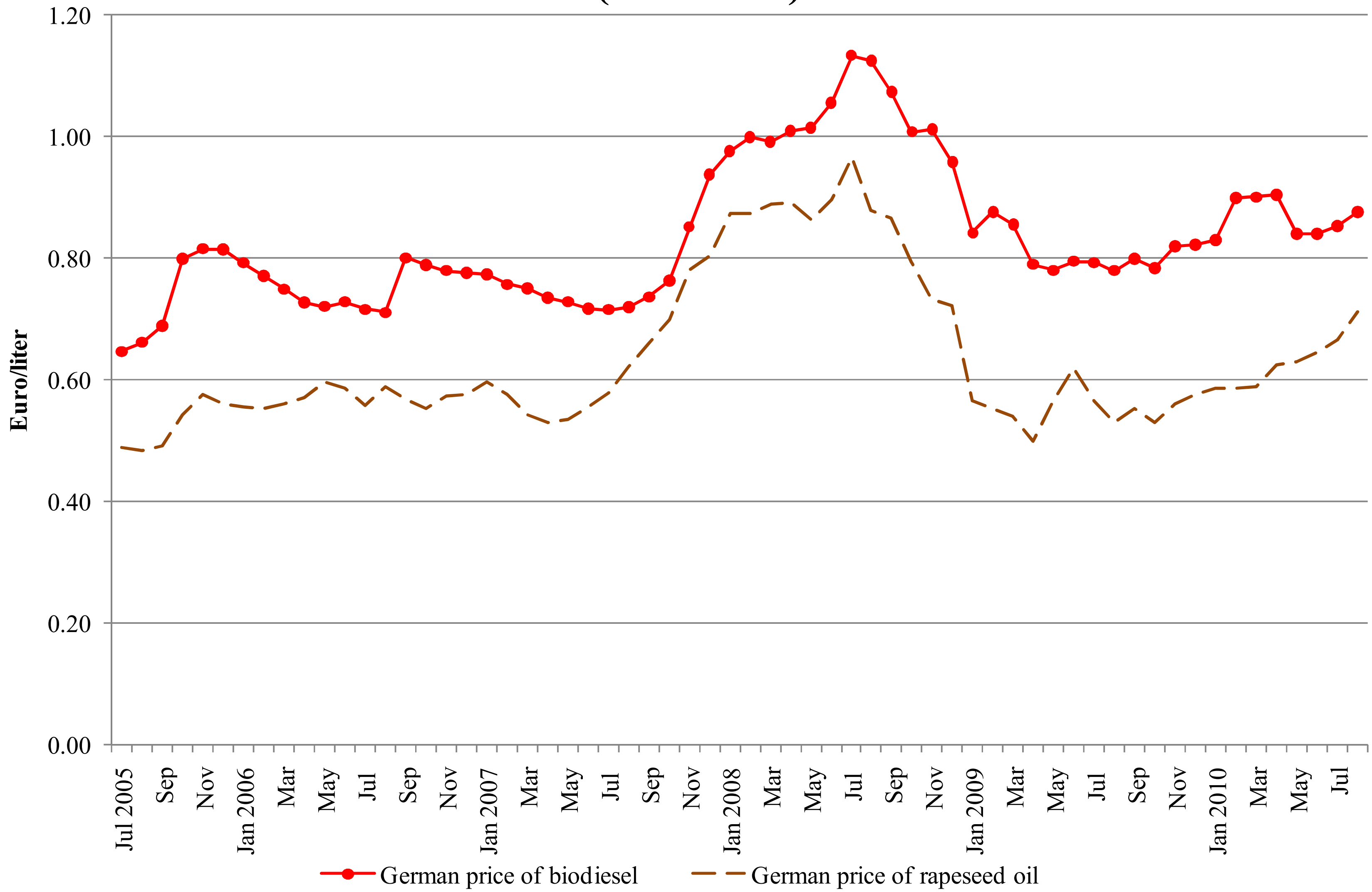


Figure 7: Imports of Biodiesel to Germany from the United States *vs* Biodiesel Market Price in Germany (July 2005 - May 2010)

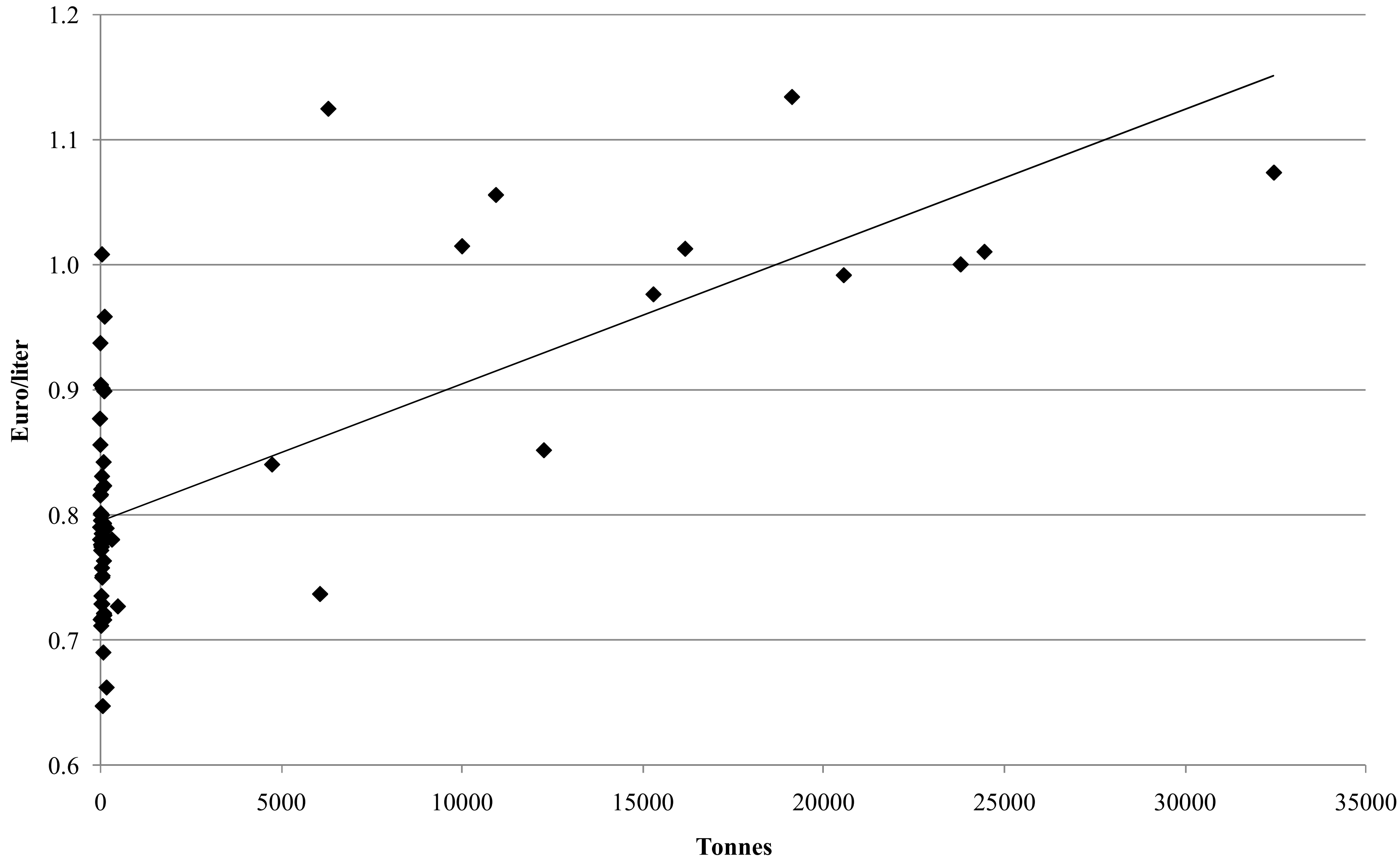


Figure 8: Difference between German Actual and Predicted Biodiesel Price and between German and U.S. Biodiesel Price (Euro/liter)

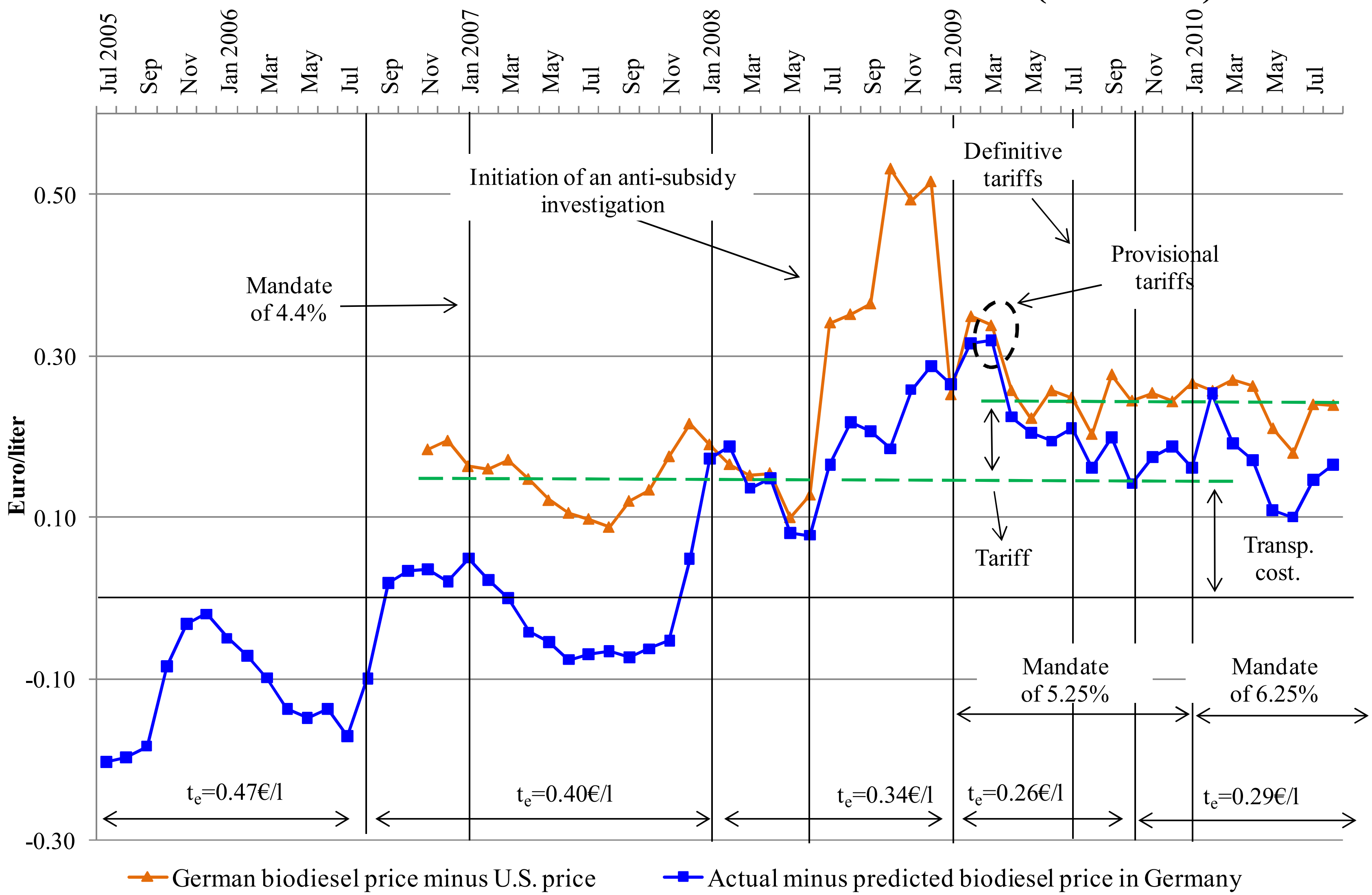


Figure 9: Actual Shares and Minimum Blends of Biofuels in Germany (energy basis)

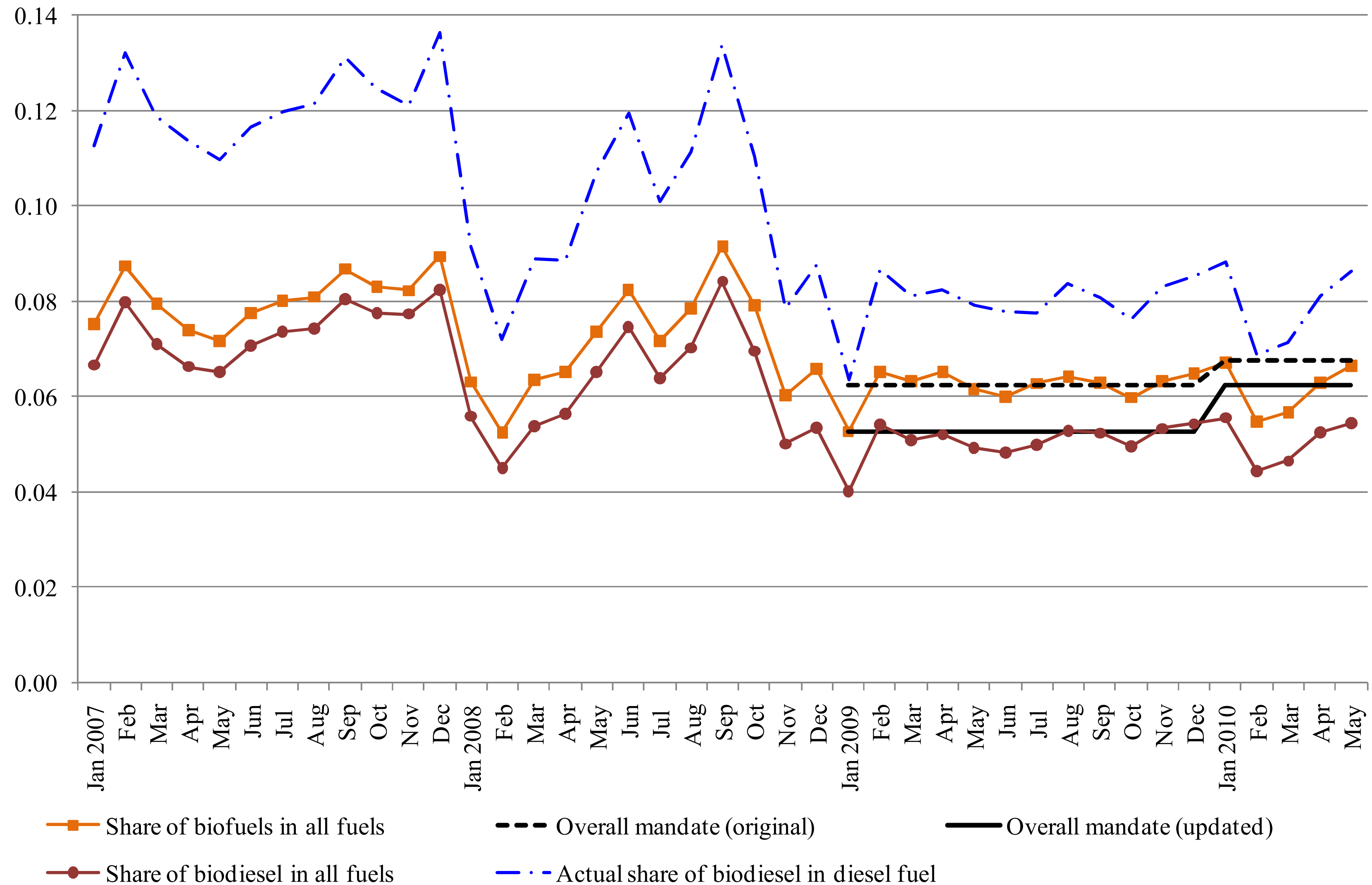


Figure 10: Actual and Hypothetical Biodiesel Share in Germany

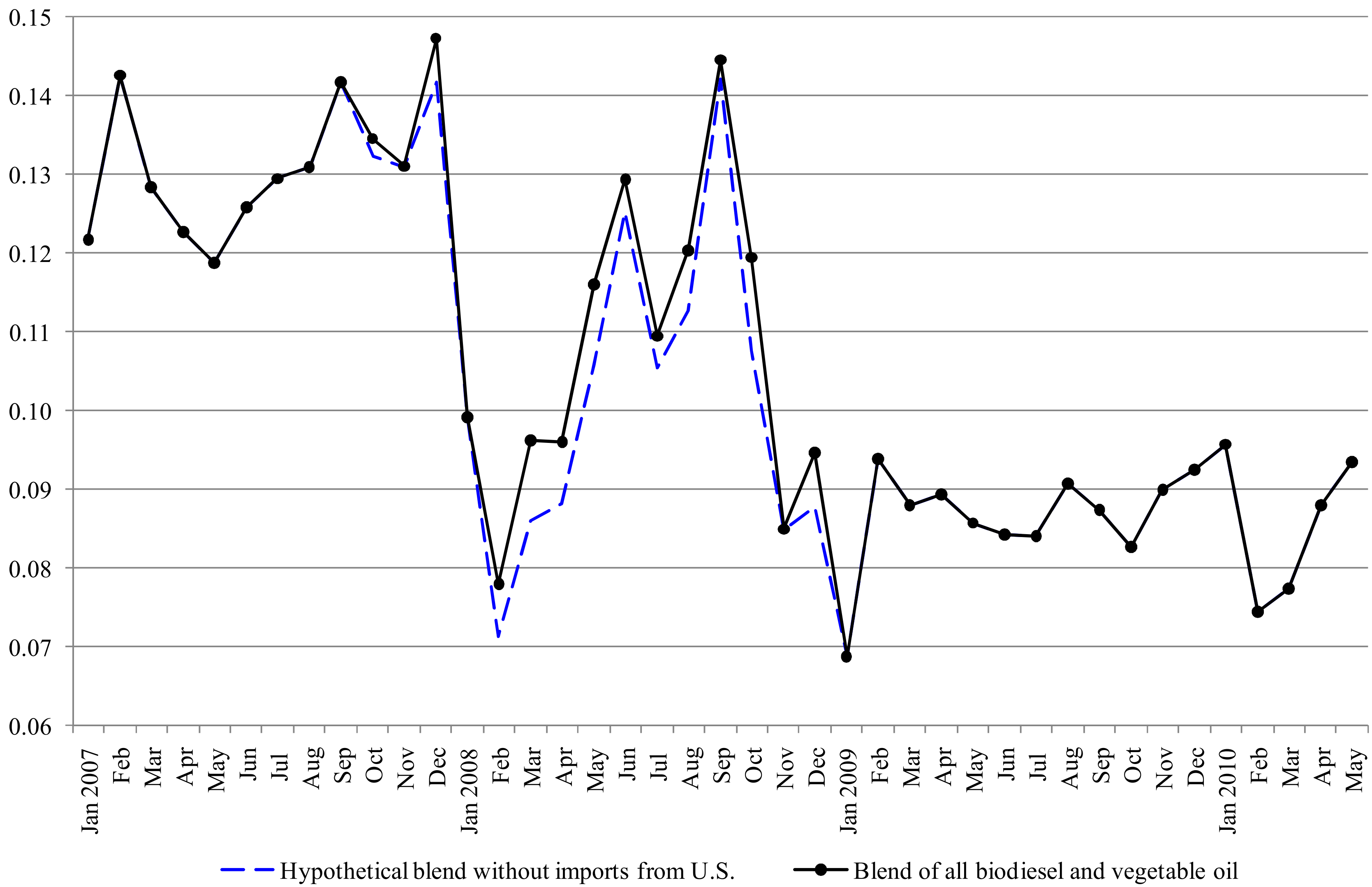


Figure 11: Biodiesel Mandate, Production, Production Capacity and Exports in the United States

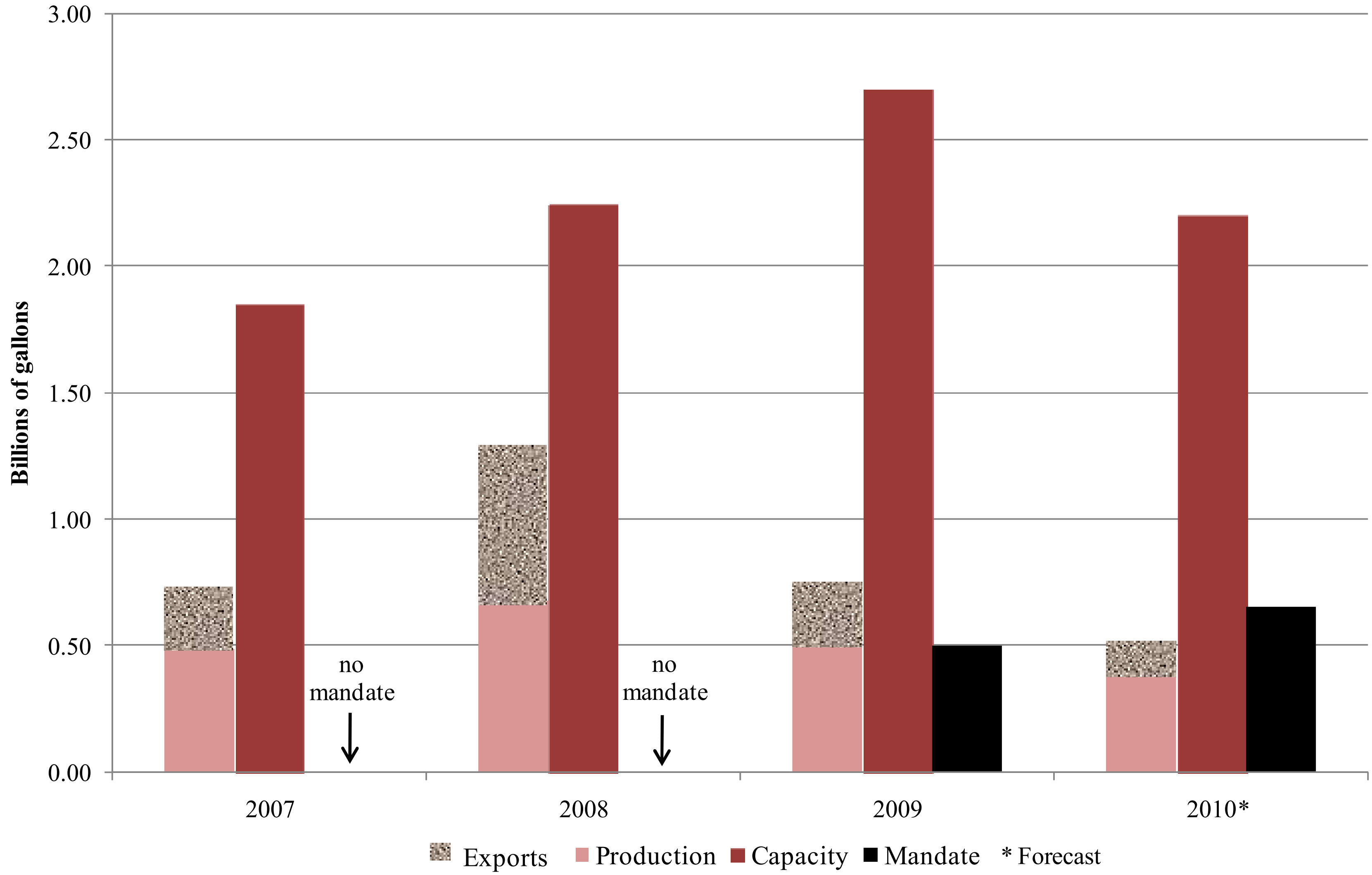


Figure 12: U.S. Biodiesel: Monthly Production, Consumption, Exports and Imports (mil. gallons)

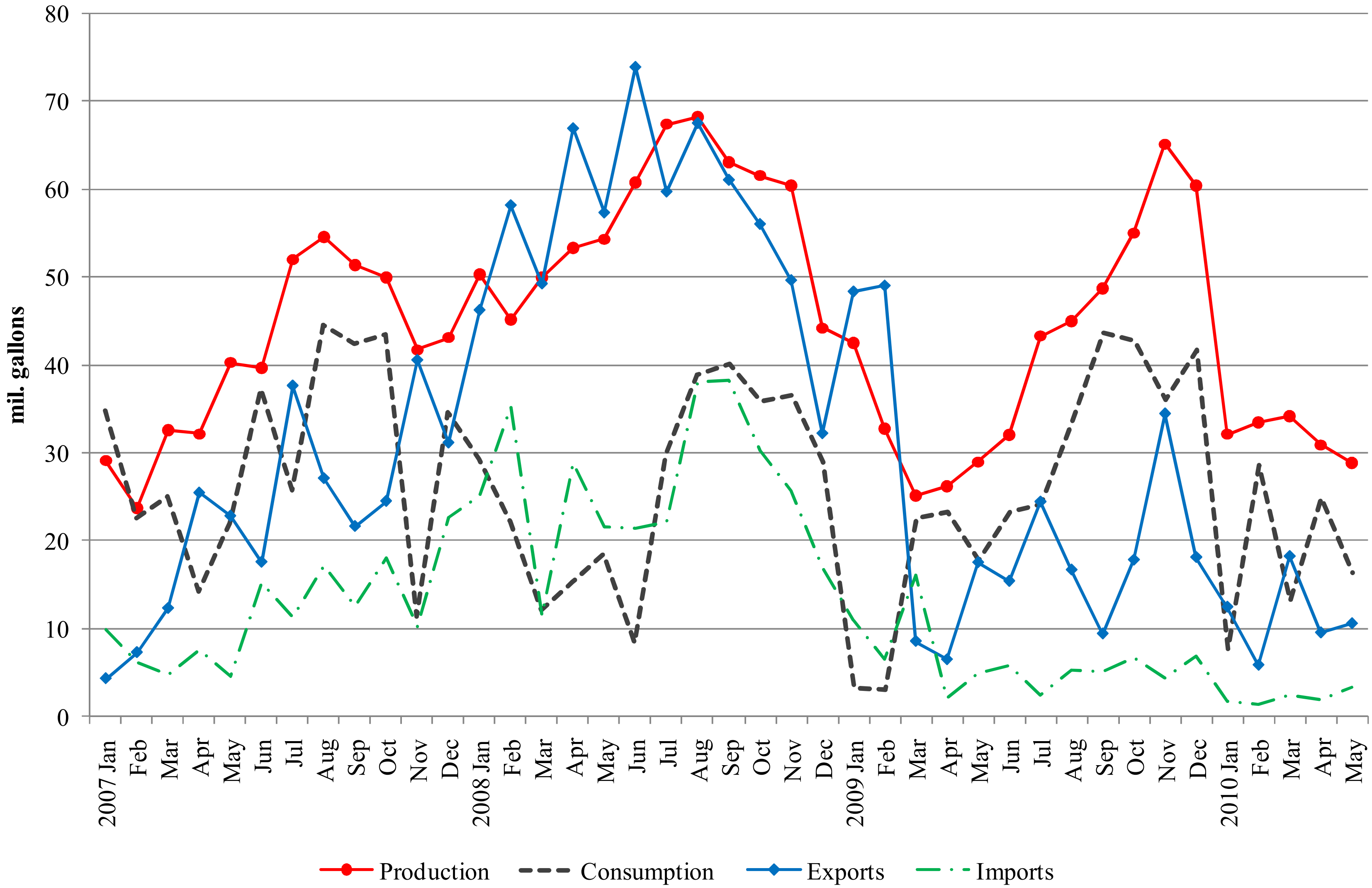
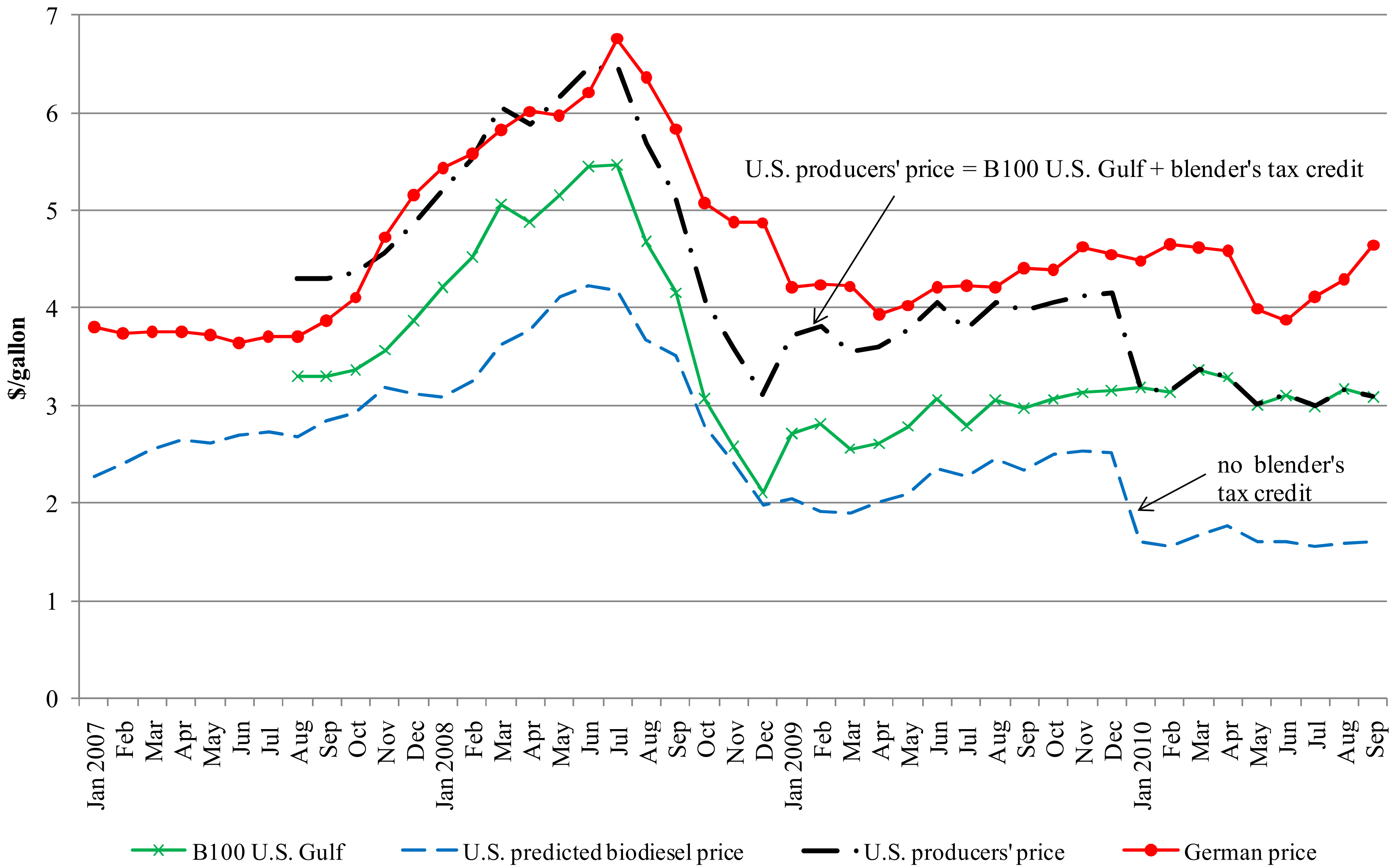


Figure 13: Actual and Predicted Biodiesel Price in the United States Compared to Actual German Price ($/gallon)



Endnotes

[1] After July 2008, the mandate in Germany is binding and with the tariff in March 2009, therefore EU continues to set the world biodiesel price.

[2] This subsidy is not 'specific' to the United States as imports are eligible (including from the European Union) so one would not expect the U.S. tax credit to be 'actionable' in the WTO by other countries.

[3] See Kliauga, de Gorter and Just (2008; 2010) for an explanation. The only way it could benefit EU biodiesel producers is if the increased consumption of fuel due to the biodiesel tax exemption would have increased the world oil price, which is highly unlikely.

[4] Germany is used as a proxy for the European Union because it is Europe's largest biodiesel producer, with a share of 28–55 percent in total European biodiesel production in the period 2002–2009. Moreover, we were able to find publically available data on biodiesel prices only for Germany.

[5] The reported biodiesel production capacities in Germany (Figure 2) and the United States (Figure 11) are underestimates of their true values as they only represent production capacities of the members of the European Biodiesel Board and the National Biodiesel Board, respectively.

[6] See Carriquiry and Babcock (2008).

[7] EU biodiesel was also eligible for 'splash & dash' and some did benefit from the program (Biodiesel magazine 2007, Carriquiry and Babcock 2008). There are at least two other pieces of evidence that at least some EU production was exported to the United States to be mixed with a 'splash' of diesel and then re-exported back to the European Union. First, the United States International Trade Commission reports imports of biodiesel from the EU in the period when the 'splash & dash' trade occurred. Second, FAS of USDA in its 2007 GAIN Report informed that a German biodiesel producer (Campa AG) because of market conditions found it more profitable to export the rapeseed oil to the U.S. and import biodiesel which benefits from the U.S. blenders credit rather than produce biodiesel from rapeseed oil in their own plant.

[8] The tariff was imposed even though U.S. Congress disallowed U.S. imports to be re-exported by making only biodiesel produced in the U.S. eligible 'splah & dash'.. The European Union still went ahead with its anti-dumping proceedings as 90 percent of the volume of biodiesel entering the EU market was produced in the United States. (EBB, 2008). The U.S. blender's tax credits for biodiesel expired at the end of 2009 and are yet to be extended, with some in the industry not only hoping for an extension of the tax credit but also for retroactive payments (Farm Futures, 2010).

[9] The federal tax credit in the United States up to December 2009 was $1/gallon. In Germany, up to July 2006, the biodiesel tax exemption was 0.4704 Euro/liter. A new rate of 0.3994 Euro/liter was in place until December 2007, followed by 0.3364 Euro/liter until the end of 2008. In 2009 the tax exemption was lowered to 0.2604 Euro/liter. However, in October 2009 the German Bundestag retroactively increased the tax exemption as of January 1, 2009, so that now it is 0.2875 Euro/liter.

[10] The only instance when the U.S. biodiesel prices dropped significantly relative to the EU prices was in November and December of 2008. At that time, the 'splash & dash' eligibility for imports into the United States only was closed i.e., re-exported biodiesel could not benefit from the tax credit.

[11] Were that the case, then the EU vehicle fleet would gradually consist of more gasoline-run vehicles. This would reduce the demand for diesel, thus possibly decreasing the diesel market price which, in turn, would lower the biodiesel price even more. Note that in the United States, diesel does not obtain preferential tax treatment vis-à-vis gasoline.

[12] Data sources for these calculations are provided in the appendix.

[13] Despite this finding, some economists (e.g., Birur, Hertel and Tyner 2009) argue that price premiums due to the additive value of ethanol are "additive" with the tax credit.

[14] The biodiesel prices are delinked completely under a consumption mandate and partially under a blend mandate.

[15] This is analogous to the argument by de Gorter and Just (2008; 2009a,b) that a tax credit is not additive with a biofuel price premium due to a mandate: only one policy instrument directly determines the gap between the biofuel and the oil-based gasoline/diesel price.

[16] Although the purpose of the U.S. blender's tax credit is to raise the price of biodiesel in the United States, we show it does not – it only expands production and exports.

[17] Although the EU production was eligible for U.S. blender's tax credit (and some EU production was exported to the United States and shipped back – see footnote 7), we do not model this as U.S. biodiesel prices averaged $1.30/gallon below EU prices over the time period 2007-2009 and so two-way transportation costs are on average not enough for EU producers to take advantage of $1/gallon (there were windows of opportunity, however, as the standard deviation of EU-U.S. price differences was $0.49/gallon). Note however that it did pay for substantial amount of U.S. imports from countries like Malaysia to be re-exported to Europe.

[18] Note that in the no-splash & dash scenario, the supply curve in the left panel of Figure 1 denotes supply of U.S. biodiesel only. This happens because of both a higher biodiesel market price and a higher tax exemption in the European Union. Therefore, non-U.S. biodiesel producers have no incentive to export to the United States.

[19] Another option for the European Union would be to enforce the mandate, which Germany is now doing.

[20] In the case of no international trade, the biodiesel market price in the U.S. would be determined independently from the European Union according to equation (4), however in this case by a blender's tax credit (unlike the European Union where it is determined by a tax exemption). Based on our calculations, in the period 2007 to 2008 the autarky biodiesel price would average $3.05/gallon, while in Europe it was $4.45/gallon in the same period.

[21] U.S. biodiesel mandate was introduced by the Energy Independence and Security Act of 2007. Originally it was scheduled to apply since 2009 but due to lack of enforcement by the Environmental Protection Agency, it supposedly is being enforced beginning July 2010 but data on biodiesel prices indicate otherwise, perhaps because of ongoing lawsuits.

[22] The U.S. Environmental Protection Agency in personal correspondence argues that "exported biodiesel (unblended or blended) is subtracted by requiring that the equivalent number of Renewable Identification Numbers (RINs) be retired". The office of Mr. Larry Schafer of the National Biodiesel Board has also confirmed that U.S. biodiesel exports are not counted towards the U.S. biodiesel mandate.

[23] The imposition of import tariffs by the European Union hurts U.S. (and third countries) biodiesel producers but U.S. taxpayers gain. Meanwhile, the EU renewable fuels target becomes more difficult to achieve without biodiesel imports. The high opportunity cost for food and feedstocks used in biodiesel production means the intercept of both the U.S. and EU biodiesel supply curves are above world oil prices. This causes 'rectangular' deadweight costs in addition to traditional deadweight cost triangles (de Gorter and Just 2008; 2009b). A 'splash & dash program' can contribute to reducing these deadweight costs, albeit, in this situation, at the expense of U.S. taxpayers (but the EU can achieve their target at less cost and so should encourage 'splash & dash', especially given the fact that EU biodiesel market price is unaffected by the 'splash & dash' scheme, provided the price premium is not determined by the mandate).

[24] Over the entire pre-tariff period the transaction costs averaged 0.22 Euro/liter. However, between July 2008 and imposition of provisional tariffs the U.S. market seems to have been in disequilibrium and so we have considered only the period of November 2006 to June 2008.

[25] The overall biofuel blend mandate is defined as the share of energy from all biofuels (ethanol and biodiesel) in total fuel (gasoline and diesel) energy.

[26] This is the period for which UFOP (Union for Promoting Oil and Protein Plants) provides relevant information to compute energy shares of biofuels in all transportation fuels.

[27] This share was calculated as (pure biodiesel + biodiesel for blend + pure vegetable oil)/(pure biodiesel + biodiesel for blend + pure vegetable oil + diesel); where the volumes were adjusted for the energy content of individual fuels.

[28] The U.S. biodiesel tax credit is projected to cost taxpayers about $2.28 billion between January of 2007 and December of 2009 (calculated as the sum of U.S. domestic biodiesel production in 2007-2009 and U.S. biodiesel imports in the period January 2007 to October 2008). The respective number of gallons was then multiplied by $1). At least $608 million of this amount was awarded to foreign-produced biodiesel.

[29] For ease of reference we talk about the EU tax exemption policy. However, transport fuels taxation is still a responsibility of individual EU member states, although the European Union has set out some framework rules and regulations that the member states must follow.