Appendix A

Section A.1

This section presents a model of the supply of immediacy in a futures market populated by hedgers (producers and retailers) and market makers (market makers and financial traders). We adapt the model in Grossman and Miller (1988) to the specific characteristics of electricity futures markets. We focus on a world with three dates: 1, 2, and 3. At date, $t = 1$, an exogenous liquidity event happens, causing an imbalance of size i_1 between the supply and demand of futures contracts[1]. Market makers compensate for the imbalance by trading futures contracts. They hold their positions until date $t = 2$, in which another liquidity event happens, causing an imbalance of size i_2. Again, market makers offset this imbalance. We assume liquidity events being of the same size but the opposite sign (i.e., $i_2 = -i_1$), and thus market makers end up closing all their futures positions. At date $t = 3$, there is no imbalance. By a temporary order imbalance, we mean asynchronous hedging needs of electricity producers and retailers[2]. For instance, if at date one some producers want to hedge their production by selling futures, but retailers are not interested in taking all the offsetting long positions, then $i_1 > 0$. Market makers offset the imbalance by taking positions (long in this case) to hold until date 2. At this date, other retailers wanting to hedge their commitments with final consumers demand long futures positions, but producers are not interested in taking all the offsetting short positions, then $i_2 < 0$. Market makers compensate for the imbalance by selling futures to retailers, closing out all their positions because they do not have generation units or commitments with final consumers.

Next, we talk about the case when an order imbalance materializes at date 1, i.e., $i_1 \neq 0$, and another order imbalance of the same size but opposite sign appears at date 2, $i_2 = -i_1$. Let P_t be a normally distributed random variable representing the futures price at time t and let $P_{t,j}$ a realization of this random variable at time j where $j \geq t$. For instance, $P_{3,3}$ is the terminal realized futures price assumed to coincide with the spot price. Let x_t be a random variable representing the size of the position in futures contracts (number of contracts times the size of each contract) owned by a hedger after trade at time t, and let B_t that hedger's holding of cash. We assume only two assets, money and a futures contract, and zero interest rates. The

[1] For instance, if at time 1 producers want to hedge their production by selling 100 futures contracts (supply), but retailers are interested in buying only 50 futures contracts (demand), then $i_1 = 100 - 50 = 50$. Market makers compensate the imbalance buying the remaining 50 contracts.

[2] The reasons justifying temporary order imbalances may be related to the hedging strategies of some market participants and are exogeneous. If these hedging needs were synchronous, the net hedging demand would be zero and there is no role for market makers.

hedger's terminal wealth is

$$W_3 = B_2 + P_3 x_3 \tag{1}$$

The size of the position in futures contracts after trading at $t = 3$ equals the size of this position after trading at time two plus the order imbalance, i.e., $x_3 = x_2 + i_1$. We assume that at times $t = 1,2$, the hedger chooses x_t and B_t to maximize the expected utility of terminal wealth $E_t\,[U(W_3)]$ at date t subject to

$$W_3 = B_2 + P_3 x_3 = B_2 + P_3 x_2 + P_3 i_1 \tag{2a}$$

$$W_2 = B_2 + P_2 x_2 = B_1 + P_2 x_1 \tag{2b}$$

$$W_1 = B_1 + P_1 x_1 = P_1 i_0 + W_0 \tag{2c}$$

Where W_0 is the initial wealth, i_0 is the initial position in the futures market before the first imbalance[3] and $B_2 = B_1 - P_2(x_2 - x_1)$. Operating in (2a) - (2c) we get

$$B_2 = B_1 - P_2 x_2 + P_2 x_1 \tag{3}$$

$$B_1 = -P_1 x_1 + W_0 \tag{4}$$

and therefore (1) can be written as

$$W_3 = W_0 + (P_2 - P_1)x_1 + (P_3 - P_2)x_2 + P_3 i_1 \tag{5}$$

and

$$W_2 = W_0 + (P_2 - P_1)x_1 \tag{6}$$

Thus

$$W_3 = W_2 + (P_3 - P_2)x_2 + P_3 i_1 \tag{7}$$

If the utility function is

[3] Without loss of generality and to simplify the exposition we assume $i_0 = 0$.

$$U(W) = -e^{-\alpha W} \tag{8}$$

Then, the optimal value of the size of the position in futures contracts of the hedger arriving at the market at date 1, and chosen at date 2, $x_2^{\mathrm{h},1}$ solves

$$Max\{x_2\}E_2[U(W_2 + (P_3 - P_2)x_2 + P_3 i_1\ )] \tag{9}$$

Using the exponential utility function, the optimal value of the equilibrium excess demand at date 2 of the hedger arriving at the market at date 1 is (see Appendix)

$$x_2^{\mathrm{h},1} = \frac{E_2[P_3] - P_{2,2}}{\alpha \mathrm{Var}_2[P_3]} - i_1 \tag{10}$$

Where $E_2[P_2]=P_{2,2}$ is the realized futures price at time 2. Note that $x_2^{h,1}$ represents the aggregate hedgers' demand, which is linear in the imbalance. We assume that M market makers face no spot price risk and with the same utility function (8) but for them, $i_1 = 0$. The total excess demand by all market makers x_2^L in period two is

$$x_2^L = M\frac{E_2[P_3] - P_{2,2}}{\alpha \mathrm{Var}_2[P_3]} \tag{11}$$

We assume that hedgers arriving at time 2 have the opposite imbalance from those who came on date 1, $i_2 = - i_1$. Their aggregate excess demand is

$$x_2^{\mathrm{h},2} = \frac{E_2[P_3] - P_{2,2}}{\alpha \mathrm{Var}_2[P_3]} + i_1 \tag{12}$$

Market clearing at date 2 requires that the excess demand of hedgers who arrived at date 1, plus market makers, plus hedgers arriving at date two should sum to zero

$$\left[\frac{E_2[P_3] - P_{2,2}}{\alpha \mathrm{Var}_2[P_3]} - i_1\right] + \left[M\frac{E_2[P_3] - P_{2,2}}{\alpha \mathrm{Var}_2[P_3]}\right] + \left[\frac{E_2[P_3] - P_{2,2}}{\alpha \mathrm{Var}_2[P_3]} + i_1\right] = 0 \tag{13}$$

Therefore $E_2[P_3] - P_{2,2} = 0$, and the equilibrium excess demand at date two of the hedger arriving at the market at date one is

$$x_2^{\mathrm{h},1} = -i_1 \tag{14}$$

The optimal date-1 demand $x_1^{\mathrm{h},1}$ of the hedger arriving at the market at date one solves

$$Max\{x_1\}E_1[U(W_0 + (P_2 - P_1) + (P_3 - P_2)x_2 + P_3 i_1)] \tag{15}$$

using $x_2 = -i_1$ and $E_2[P_3] = P_{2,2}$ this becomes

$$Max\{x_1\}E_1[U(W_0 + (E_2[P_3] - P_1)x_1 + i_1 E_2[P_3])] \tag{16}$$

By using the law of iterated expectations where $E_1[E_2[P_3]] = E_1[P_3]$, in the Appendix, we show that the optimal value of the equilibrium excess demand at date 1 of the hedgers arriving at the market at date 1 is

$$x_1^{\mathrm{h},1} = \frac{E_1[P_3] - P_{1,1}}{\alpha \mathrm{Var}_1\left[E_2[P_3]\right]} - \ i_1 \tag{17}$$

There are M market makers. They solve the same maximization problem as the hedgers, but for them, $i_1 = 0$. At date 1, the excess demand of a liquidity provider is

$$x_1^L = \frac{E_1[P_3] - P_{1,1}}{\alpha \mathrm{Var}_1\left[E_2[P_3]\right]} \tag{18}$$

Market clearing at date 1 requires that the excess demand of hedgers who arrived at date 1, plus the demand of the M market makers, should sum to zero

$$\left[\frac{E_1[P_3] - P_{1,1}}{\alpha \mathrm{Var}_1\left[E_2[P_3]\right]} - i_1\right] + \left[M\frac{E_1[P_3] - P_{1,1}}{\alpha \mathrm{Var}_1\left[E_2[P_3]\right]}\right] = 0 \tag{19}$$

Therefore

$$\left[\frac{E_1[P_3] - P_{1,1}}{\alpha \mathrm{Var}_1\left[E_2[P_3]\right]}\right] = \frac{i_1}{(1+M)} \tag{20}$$

Let

$$r_2 = \frac{P_{2,2} - P_{1,1}}{P_{1,1}} \tag{21}$$

The excess return earned by market makers from date 1 to date 2. We show in the Appendix that its expected value at time 1 is

$$E_1[r_2] = \frac{\left(i_1 P_{1,1}\right)\alpha \mathrm{Var}_1[r_2]}{(1+M)} \tag{22}$$

Notice that the excess return expected by market makers decreases with the number of market makers M and increases with the size of the imbalance i_1, the degree of risk aversion α, and the variance of the return. If $i_1 > 0$ (hedgers sell futures contracts to market makers who consequently assume a net long position), a positive value of $P_{1,1}$ implies a positive expected return because market makers expect a profit when closing their position at higher futures prices in $t = 2$, and therefore $E_1[P_2] > P_{1,1}$. Alternatively, if $i_1 < 0$ (hedgers buy futures contracts from market makers), a positive value of $P_{1,1}$ implies $E_1[P_2] < P_{1,1}$, meaning that market makers expect a profit when closing their position (selling futures) at lower futures prices in $t = 2$. In the presence of synchronization, no change in price is expected, and therefore $E_1[r_2]=0$.

Using (18) and (20), the inventory held by a typical liquidity provider is

$$P_{1,1}x_1^L = \frac{i_1 P_{1,1}}{1+M} = \frac{E_1[r_2]}{(\alpha \mathrm{Var}_1[r_2])} \tag{23}$$

The more extensive the inventory, the larger the expected return between date one and date two. For a given expected return, the lower the return's predictability (, the higher the expected variance) and the higher the risk-aversion parameter, the lower the inventory. Let

$$r_3 = \frac{P_{3,3} - P_{2,2}}{P_{2,2}} \tag{24}$$

The excess return of a futures contract earned by market makers from date 2 to date 3. The expected return at date two is

$$E_2[r_3] = \frac{E_2[P_3]}{P_{2,2}} - 1 = 0 \tag{25}$$

Because $E_2[P_3] = P_{2,2}$ and liquidity traders do not hold trading positions from t =2 to t = 3.

Section A.2

In this section, we present detailed derivations of some equations in A.1. The empirical implication of the model is that if an imbalance appears at time 1, the return of the futures contract between t = 1 and t = 2 (when liquidity traders close their positions because of the second imbalance of opposite sign) should be positive (negative) if the initial imbalance is positive (negative). If no new imbalance appears, then the expected return between t = 2 and t = 3 should be zero.

Let

$$W_3 = W_2 + (P_3 - P_2)x_2 + P_3 i \tag{A.1}$$

and

$$U(W_3) = -e^{-\alpha W_3} \tag{A.2}$$

Then, the optimal value of the size of the position in futures contracts of the hedger arriving at the market at date 1, and chosen at date 2, $x_2^{\mathrm{h},1}$ solves

$$Max\{x_2\}\ E_2[U(W_2 + (P_3 - P_2)x_2 + P_3 i_1\ )] \qquad (A.3)$$

In the derivation we use $E_2[P_2] = P_{2,2}$

$$\frac{\partial E_2[U(W_3)]}{\partial x_2} = -\frac{1}{2}e^{\frac{1}{2}\alpha\left(i_1(-2E_2[P_3]+i_1 Var_2[P_3]\alpha)-2W_2+2\left(-E_2[P_3]+i_1 Var_2[P_3]\alpha+P_{2,2}\right)x_2+Var_2[P_3]\alpha x_2^2\right)}\alpha\Big(2\big(-E_2[P_3] + i_1 Var_2[P_3]\alpha + P_{2,2}\big) + 2Var_2[P_3]\alpha x_2\Big) \qquad (A.4)$$

Solving for the optimal value of the equilibrium excess demand at date 2 of the hedger arriving at the market at date 1, $x_2^{\mathrm{h},1}$ gives

$$x_2^{\mathrm{h},1} = \frac{E_2[P_3] - P_{2,2}}{\alpha \mathrm{Var}_2[P_3]} - i_1 \qquad (A.5)$$

Notice (A.5) is equation (10) in the main text.

The optimal date-1 demand $x_1^{\mathrm{h},1}$ of the hedger arriving at the market at date one solves

$$Max\{x_1\}E_1[U(W_0 + (P_2 - P_1) + (P_3 - P_2)x_2 + P_3 i_1\ )] \qquad (A.6)$$

using $x_2 = -i_1$ this becomes

$$Max\{x_1\}E_1[U(W_0 + (E_2[P_3] - P_1)x_1 + i_1 E_2[P_3])] \qquad (A.7)$$

By using the law of iterated expectations where $E_1[E_2[P_3]] = E_1[P_3]$ and the same procedure as in equations (A.3) and (A.4) and $E_1[P_1] = P_{1,1}$, the optimal value of the equilibrium excess demand at date 1 of the hedgers arriving at the market at date one is

$$x_1^{\mathrm{h},1} = \frac{E_1[P_3] - P_{1,1}}{\alpha \mathrm{Var}_1\left[E_2[P_3]\right]} - \ i_1 \qquad (A.8)$$

This is equation (17).

Let

$$r_2 = \frac{P_2 - \ P_{1,1}}{P_{1,1}} \qquad (A.9)$$

The excess return earned by liquidity providers from date 1 to date 2. Manipulating (A.9) gives

$$r_2 = \frac{P_2}{P_{1,1}} - 1 \qquad (A.10)$$

Equation (20) is

$$\left[\frac{E_1[P_3] - P_{1,1}}{\alpha \mathrm{Var}_1\left[E_2[P_3]\right]}\right] = \frac{i_1}{(1+M)} \qquad (A.11)$$

Using $P_2=(r_2+1)P_{1,1}$, $E_1[P_3] = E_1[P_2]$, and $E_2[P_3] = P_2$ in the left-hand-side of (A.11) we get

$$\frac{E_1[P_3] - P_{1,1}}{\alpha \mathrm{Var}_1\left[E_2[P_3]\right]} = \frac{E_1[P_2] - P_{1,1}}{\alpha \mathrm{Var}_1\left[[P_2]\right]} \qquad (A.12)$$

$$\frac{E_1[P_2] - P_{1,1}}{\alpha \mathrm{Var}_1[P_2]} = \frac{E_1\left[(r_2+1)P_{1,1}\right] - P_{1,1}}{\alpha \mathrm{Var}_1\left[(r_2+1)P_{1,1}\right]} \qquad (A.13)$$

$$\frac{E_1\left[(r_2+1)P_{1,1}\right]-P_{1,1}}{\alpha\mathrm{Var}_1\left[(r_2+1)P_{1,1}\right]}=\frac{E_1[r_2]}{P_{1,1}\alpha\mathrm{Var}_1[r_2]} \qquad (A.14)$$

And thus, using (A.8)

$$E_1[r_2]=\frac{\left(i_1P_{1,1}\right)\alpha\mathrm{Var}_1[r_2]}{(1+M)} \qquad (A.15)$$

Notice (A.15) is equation (22) in the main text.

Section A.3

In this section, we present a robustness test of the empirical results. We run the regression (4) using baseload contracts only. The following tables contain regression results with baseload contracts only. The number of observations is 146,124; 45,644 in the German market, 22,045 in the French market, 28,161 in the Spanish market, and 50,274 in the Nordic market. Panel A contains results for the French market, Panel B for the German market, Panel C for the Nordic market, and Panel D for the Spanish market

PANEL A: FR					
	M	Q	Y	MQ	MQY
	b/t	b/t	b/t	b/t	b/t
I_1	-0.001	-0.001535*	-0.001912*	-0.001	-0.001532*
	-0.874	-4.272	-6.487	-2.501	-3.966
I_2	-0.001	-0.001831*	-0.002020*	-0.002	-0.001735*
	-0.786	-4.201	-6.375	-2.437	-4.062
I_3	0.001	0.001	0.002	0.000	0.000
	0.271	0.277	0.482	0.230	0.184
dlvol	0.000	0.000	0.000	0.000	0.000
	1.896	-0.050	2.189	1.625	2.246
lgas	0.201868*	0.107287*	0.069544*	0.142961*	0.116507*
	7.007	7.079	7.015	8.518	9.473
loil	0.015	0.046880*	0.036634*	0.034973*	0.035756*
	1.118	9.107	11.680	5.718	8.586
lcoal	0.122600*	0.117963*	0.088962*	0.121471*	0.109527*
	4.337	15.237	11.541	11.291	13.938
lcarbon	0.106275*	0.110746*	0.094532*	0.109475*	0.105395*
	8.144	6.485	5.274	9.712	10.825
lcac	0.009	0.050238*	0.037817*	0.035137*	0.035188*
	0.411	4.008	6.461	2.993	4.395
varfr	-0.042	-0.011	-0.004	-0.021412*	-0.014440*
	-2.194	-1.865	-1.083	-3.017	-3.410
skewfr	0.001	0.000	0.000	0.000	0.000
	1.427	0.443	0.497	1.753	1.942
2.mes	-0.001	0.000	0.000846*	0.000	0.000
	-0.467	1.009	4.290	-0.086	0.525
3.mes	0.003	0.002854*	0.003299*	0.002912*	0.003029*
	2.317	5.668	10.175	4.593	6.630
4.mes	0.002	0.002729*	0.003475*	0.002450*	0.002766*
	1.333	4.773	4.572	3.220	4.863
5.mes	0.000	0.002017*	0.002744*	0.001	0.001753*
	0.198	3.436	8.475	1.805	3.437
6.mes	0.004	0.003207*	0.003541*	0.003388*	0.003414*
	2.504	5.784	6.931	4.812	6.651
7.mes	0.003	0.001431*	0.001130*	0.001905*	0.001669*
	1.698	3.261	3.439	2.743	3.460
8.mes	0.002	0.001629*	0.001875*	0.001781*	0.001784*
	1.657	3.783	9.979	2.949	4.185
9.mes	0.002	0.002111*	0.001	0.002	0.001825*
	0.950	3.436	2.585	2.547	3.334
10.mes	0.005	0.002083*	0.002069*	0.003090*	0.002841*
	1.902	3.518	4.076	3.027	3.928
11.mes	0.000	0.001	0.001	0.001	0.001
	0.039	2.045	1.573	0.942	1.364
12.mes	-0.003	0.001	0.001	-0.001	0.000
	-1.766	1.000	2.054	-0.832	-0.199
N	5440	8384	6338	13824	20162
R-sq	11.76%	20.17%	22.92%	14.07%	14.76%

	PANEL B: GE				
	M	Q	Y	MQ	MQY
	b/t	b/t	b/t	b/t	b/t
I_1	-0.001292*	-0.001460*	-0.001894*	-0.001378*	-0.001512*
	-3.213	-8.077	-44.984	-6.409	-9.037
I_2	-0.001	-0.001685*	-0.001840*	-0.001495*	-0.001575*
	-2.603	-5.726	-9.261	-5.351	-7.616
I_3	-0.003	0.000	0.002	-0.002390*	-0.002436*
	-2.616	0.198	0.982	-2.772	-2.894
dlvol	0.000	0.000	0.000	0.000	0.000
	0.606	0.016	2.073	0.487	1.044
lgas	0.117311*	0.085149*	0.064856*	0.099595*	0.090959*
	11.949	12.244	8.654	15.927	16.769
loil	0.027125*	0.045342*	0.039695*	0.037112*	0.037966*
	5.676	13.711	10.854	12.470	15.971
lcoal	0.119516*	0.124620*	0.091657*	0.122374*	0.114789*
	9.425	15.113	8.138	16.997	17.556
lcarbon	0.108412*	0.113788*	0.092342*	0.111384*	0.106563*
	12.948	10.339	9.955	15.916	18.019
ldax	0.012	0.045196*	0.030579*	0.030232*	0.030236*
	0.777	5.418	4.332	3.638	4.613
varge	0.000	-0.001	-0.001	0.000	-0.001
	-0.396	-2.157	-1.653	-1.504	-2.082
skewge	0.000	0.000	0.000	0.000	0.000
	-0.044	0.084	1.724	0.029	0.474
2.mes	-0.001	0.000	0.001080*	0.000	0.000
	-1.028	1.366	4.041	-0.209	0.828
3.mes	0.001829*	0.002436*	0.002759*	0.002178*	0.002322*
	3.715	7.575	7.976	7.491	9.937
4.mes	0.002533*	0.002881*	0.003207*	0.002719*	0.002853*
	4.158	8.265	10.244	8.001	10.689
5.mes	0.001	0.001711*	0.002479*	0.001547*	0.001787*
	2.289	5.160	6.466	4.736	6.686
6.mes	0.001661*	0.001815*	0.002056*	0.001762*	0.001840*
	2.876	4.951	5.862	5.285	6.908
7.mes	0.000	0.000926*	0.001140*	0.000715*	0.000834*
	0.889	4.437	7.023	2.625	3.934
8.mes	0.001	0.001194*	0.001445*	0.001183*	0.001249*
	2.290	3.936	7.534	3.979	5.384
9.mes	0.000	0.000629*	0.001	0.001	0.000679*
	1.022	3.101	3.256	2.370	3.404
10.mes	0.001	0.001155*	0.001185*	0.001054*	0.001097*
	1.827	4.079	5.226	3.680	4.934
11.mes	0.000	0.000871*	0.001102*	0.000	0.001
	-0.193	3.183	8.093	1.200	2.248
12.mes	0.001	0.001416*	0.001863*	0.001062*	0.001281*
	1.272	6.285	10.927	3.898	5.951
N	13963	16972	10168	30935	41103
R-sq	19.87%	27.27%	26.82%	22.99%	23.28%

PANEL C: NP					
	M	Q	Y	MQ	MQY
	b/t	b/t	b/t	b/t	b/t
I_1	-0.005	-0.001	-0.002	-0.003	-0.003
	-1.633	-1.015	-1.180	-1.920	-2.146
I_2	-0.006	-0.002	-0.002	-0.003	-0.003
	-1.709	-1.006	-1.060	-1.985	-2.191
I_3	-0.007	-0.001	0.000	-0.004	-0.004
	-1.873	-0.469		-1.959	-2.002
dlvol	0.000	-0.000157*	0.000	-0.000098*	-0.000085*
	0.618	-4.922	-1.765	-3.244	-3.498
lgas	0.118885*	0.095186*	0.068347*	0.104070*	0.095914*
	7.872	13.408	11.414	14.284	15.769
loil	0.024297*	0.038186*	0.031508*	0.033314*	0.033039*
	3.153	9.613	9.374	8.663	10.962
lcoal	0.188352*	0.150716*	0.116263*	0.165257*	0.154422*
	9.047	18.595	15.628	17.268	19.576
lcarbon	0.115837*	0.111360*	0.089843*	0.113172*	0.107704*
	12.522	10.474	8.439	15.002	16.725
lobx	0.136358*	0.172239*	0.135003*	0.158169*	0.152741*
	9.840	12.555	5.834	15.476	15.503
varnord	0.031	0.012	0.006	0.018705*	0.015653*
	2.081	2.038	0.980	2.744	2.887
skewnord	0.000	0.000	0.000	0.000	0.000
	0.162	-1.097	-1.766	-0.624	-1.080
RESM	0.011	0.002	0.001	0.005	0.005
	2.554	0.941	0.522	2.482	2.475
RESD	-0.003	-0.002603*	-0.002	-0.003	-0.002523*
	-1.147	-3.096	-2.101	-2.468	-2.790
2.mes	-0.002	-0.001361*	-0.001	-0.001683*	-0.001434*
	-1.668	-3.035	-1.274	-2.993	-3.136
3.mes	0.000	0.001	0.002	0.001	0.001
	0.062	2.251	2.510	1.073	1.598
4.mes	0.001	0.001846*	0.002273*	0.002	0.001757*
	0.625	2.745	3.388	2.164	2.929
5.mes	-0.001	0.001	0.002	0.001	0.001
	-0.295	2.450	3.170	0.829	1.611
6.mes	-0.003	0.000	0.001	-0.001	-0.001
	-2.386	-1.478	3.239	-2.591	-2.074
7.mes	-0.006415*	-0.001	0.000	-0.003067*	-0.002373*
	-4.694	-1.499	0.074	-4.071	-3.750
8.mes	-0.003899*	0.000	0.000	-0.001604*	-0.001
	-3.388	-0.639	0.599	-2.625	-2.299
9.mes	-0.005890*	-0.001	0.000	-0.002675*	-0.002006*
	-4.689	-1.117	0.387	-3.658	-3.178
10.mes	-0.003971*	-0.001	0.000	-0.002	-0.001
	-3.247	-0.758	0.333	-2.526	-2.294
11.mes	-0.005301*	-0.001	0.000	-0.002786*	-0.002242*
	-3.735	-2.100	-0.417	-3.864	-3.777
12.mes	-0.004576*	-0.001	0.000	-0.001987*	-0.001
	-3.479	-0.605	0.447	-2.662	-2.382
N	11919	19795	9703	31714	41417
R-sq	11.16%	21.52%	25.99%	15.56%	16.35%

PANEL D: SP					
	M	Q	Y	MQ	MQY
	b/t	b/t	b/t	b/t	b/t
I_1	-0.002406*	-0.001670*	-0.001756*	-0.001981*	-0.001942*
	-3.182	-4.707	-4.627	-5.109	-5.835
I_2	-0.003114*	-0.001657*	-0.001703*	-0.002304*	-0.002137*
	-3.528	-4.220	-4.655	-5.136	-5.937
I_3	-0.004896*	-0.003	-0.002	-0.004253*	-0.004178*
	-3.389	-2.609	-0.738	-3.847	-3.905
dlvol	0.000	0.000	0.000	0.000	0.000
	-2.466	0.592	-0.474	-1.751	-1.810
lgas	0.033009*	0.037308*	0.042549*	0.035414*	0.036756*
	3.799	4.820	6.394	6.118	7.471
loil	0.028316*	0.042017*	0.035860*	0.036111*	0.036142*
	4.363	7.796	3.975	8.447	9.442
lcoal	0.046068*	0.070379*	0.064177*	0.060410*	0.061043*
	4.212	11.343	8.592	10.301	12.114
lcarbon	0.041305*	0.044103*	0.036577*	0.043030*	0.041692*
	10.138	7.214	4.893	10.962	11.947
libex	-0.001	0.021864*	0.028	0.012	0.014
	-0.078	2.731	2.396	1.733	2.488
varsp	0.000	-0.001347*	-0.001549*	-0.001	-0.000867*
	0.419	-5.768	-3.764	-1.759	-2.723
Skewsp	0.000698*	0.000246*	0.000	0.000446*	0.000388*
	3.059	2.741	1.221	3.878	3.996
2.mes	0.001	0.001029*	0.000943*	0.001	0.000917*
	0.803	3.339	3.407	2.331	2.803
3.mes	0.002	0.002611*	0.002753*	0.002506*	0.002566*
	2.155	5.400	3.462	5.005	5.849
4.mes	0.003841*	0.003122*	0.003102*	0.003460*	0.003405*
	3.695	5.746	4.916	6.285	7.243
5.mes	0.003995*	0.003219*	0.002948*	0.003550*	0.003443*
	4.056	5.537	3.795	6.545	7.328
6.mes	0.002	0.001914*	0.001983*	0.001876*	0.001907*
	1.805	4.562	3.526	4.100	4.860
7.mes	0.002	0.001016*	0.001334*	0.001275*	0.001293*
	1.877	3.194	6.313	3.024	3.659
8.mes	0.002798*	0.001693*	0.001599*	0.002177*	0.002072*
	3.250	3.891	3.332	4.816	5.379
9.mes	0.002521*	0.001204*	0.001456*	0.001742*	0.001693*
	2.707	3.836	4.640	3.950	4.583
10.mes	0.002244*	0.001099*	0.001433*	0.001639*	0.001607*
	2.771	3.243	4.138	3.976	4.654
11.mes	0.002608*	0.002025*	0.001938*	0.002265*	0.002206*
	2.892	4.683	6.432	4.831	5.697
12.mes	0.002	0.001335*	0.001572*	0.001778*	0.001750*
	2.422	3.594	3.457	3.732	4.440
N	8761	11433	4944	20194	25138
R-sq	3.77%	10.33%	14.01%	5.99%	6.63%