**Appendix C: The Test for the Endogeneity**

To test for the endogeneity we extended the approach proposed by Naik and Tsai (2000) to the non-linear models. We test for the measurement error in the contributions of the Mozilla Add-on Organization (AMO), and in the smoothed effects of the new releases of the Mozilla platform and its complements. The importance of accounting for the measurement error in the AMO contributions processes raise not only in the estimation procedure, but also in the convergence to the suboptimal solution in the optimization, as proposed by Naik and Tsai (2000). To test for the measurement errors in the AMO contribution process, first we model the AMO process as a first order Markov chain with a drift and a stochastic error term. Then we extend our approach to model the supply side decision of the AMO. In particular, we model that the length of the AMO nomination queue drives the AMO contributions level. More formally in the first step we model:

(E1)

where  denotes the observed AMO contribution level, and  denotes the latent AMO contribution level, and are the parameters to estimate. In the second step we change the state equation of the latent AMO contribution level as the following:

 (E2)

We can rewrite these models in the form of the state space equations, formally as:

 (E3)

(E4)

 (E5)

(E6)

 (E7)

To estimate these models, we use a two-step approach. In the first step conditional on the latent AMO contribution, and the error distribution (), we estimate  using an Extended Kalman Filter (EKF). Then in the second step conditional on , we use (E4) as the observation equation, (E5) as the state equation, and (E6) as the joint variance to estimate the latent AMO contribution. The results of this estimation for both of the models are presented in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | Estimate | Mean | STD | 2.5% | 97.5% |
| Model 1 | Corr | 0.014 | 0.126 | -0.198 | 0.223 |
|  |  | 0.0005 | 0.005 | -0.007 | 0.008 |
| Model 2 | Corr | -0.002 | 0.115 | -0.195 | 0.193 |
|  |  | -3.5e-5 | 0.005 | -0.008 | 0.008 |

The correlation and the off diagonal elements of the var-cov matrix suggest that there are no measurement errors.

To test for the endogeneity of the smooth version of the new releases of Mozilla platform and its complements, we use the same approach. In particular we model the new releases of the platform and its complements as a separate first order Markov chain with the drifts and the stochastic error terms. In this case our state equation for each add-on consists of two additional equations: a smoothed effect of the Mozilla platform release and a smoothed effect of the add-on release. Therefore, the second stage of the estimation procedure in this case uses three observation equations. The first two observation equations relate the observed smoothed effect with the unobserved new releases effects, and the third observation equation relates the latent diffusion level to the latent unobserved effect of the new releases. Following table presents the confidence intervals:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Corr | | Corr | |  | |  | |
| Add-on | 2.5% | 97.5% | 2.5% | 97.5% | 2.5% | 97.5% | 2.5% | 97.5% |
| 1 | -0.1012 | 0.0001 | -0.1033 | 0.0139 | -0.0004 | 0.0000 | -0.0003 | 0.0000 |
| 2 | -0.0324 | 0.0320 | -0.0332 | 0.0454 | -0.0002 | 0.0001 | -0.0001 | 0.0001 |
| 3 | -0.0951 | 0.0309 | -0.0829 | 0.0623 | -0.0001 | 0.0000 | -0.0003 | 0.0001 |
| 4 | -0.0001 | 0.0000 | -0.0002 | 0.0001 | -0.0603 | 0.0216 | -0.0437 | 0.0378 |
| 5 | -0.0738\* | -0.0024\* | -0.0172 | 0.0592 | -0.0002 | 0.0000 | -0.0001 | 0.0001 |
| 6 | -0.112\* | -0.001\* | -0.051 | 0.049 | -8.e-5\* | -3.e-5\* | -0.0001 | 0.0001 |
| 7 | -0.038 | 0.042 | -0.037 | 0.042 | -0.0001 | 0.0001 | -0.0001 | 0.0001 |
| 8 | -0.054 | 0.025 | -0.024 | 0.063 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 9 | -0.023 | 0.037 | -0.046 | 0.032 | -0.0001 | 0.0001 | -0.0002 | 0.0001 |
| 10 | -0.034 | 0.035 | -0.042 | 0.042 | -0.0001 | 0.0001 | -0.0001 | 0.0001 |
| 11 | -0.063 | 0.028 | -0.024 | 0.070 | -0.0002 | 0.0000 | -0.0002 | 0.0002 |
| 12 | -0.009 | 0.090 | -0.059 | 0.034 | -0.0001 | 0.0001 | -0.0002 | 0.0001 |
| 13 | -0.060 | 0.041 | -0.041 | 0.060 | -0.0002 | 0.0001 | -0.0001 | 0.0001 |
| 14 | -0.092 | 0.006 | -0.025 | 0.067 | -0.0004 | 0.0001 | -0.0002 | 0.0002 |
| 15 | -0.041 | 0.034 | -0.015 | 0.057 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 16 | -0.0888 | 0.0250 | -0.0381 | 0.0690 | -0.0003 | 0.0000 | -0.0002 | 0.0002 |
| 17 | -0.0904 | 0.0387 | -0.0360 | 0.0518 | -0.0003 | 0.0001 | -0.0001 | 0.0001 |
| 18 | -0.0599 | 0.0423 | -0.0690 | 0.0474 | -0.0004 | 0.0002 | -0.0003 | 0.0002 |
| 19 | -0.0865 | 0.0402 | -0.0789 | 0.0490 | -0.0005 | 0.0002 | -0.0005 | 0.0002 |
| 20 | -0.0699 | 0.0325 | -0.0435 | 0.0520 | -0.0002 | 0.0001 | -0.0001 | 0.0001 |
| 21 | -0.061 | 0.032 | -0.040 | 0.055 | -0.0002 | 0.0001 | -0.0001 | 0.0001 |
| 22 | -0.074 | 0.024 | -0.038 | 0.061 | -0.0002 | 0.0001 | -0.0001 | 0.0001 |
| 23 | -0.273\* | -0.115\* | -0.084 | 0.039 | -0.0002 | -0.0001 | -0.0003 | 0.0001 |
| 24 | -0.132\* | -0.010\* | -0.063 | 0.049 | -0.0003 | 0.0000 | -0.0004 | 0.0002 |
| 25 | -0.097 | 0.017 | -0.066 | 0.048 | -0.0004 | 0.0001 | -0.0004 | 0.0002 |
| 26 | -0.020 | 0.054 | -0.016 | 0.057 | -0.0001 | 0.0001 | -0.0001 | 0.0001 |
| 27 | -0.094 | 0.049 | -0.059 | 0.075 | -0.0002 | 0.0000 | -0.0002 | 0.0001 |
| 28 | -0.051 | 0.028 | -0.014 | 0.075 | -0.0002 | 0.0001 | -0.0001 | 0.0001 |
| 29 | -0.081 | 0.017 | -0.037 | 0.055 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 30 | -0.083 | 0.008 | -0.026 | 0.074 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 31 | -0.060 | 0.024 | -0.030 | 0.056 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 32 | -0.081 | 0.017 | -0.060 | 0.023 | -0.0001 | 0.0000 | -0.0002 | 0.0000 |
| 33 | -0.010 | 0.047 | -0.068 | -0.007 | -0.0001 | 0.0001 | -0.0002 | 0.0000 |
| 34 | -0.118 | 0.082 | -0.110 | 0.099 | -0.0008 | 0.0004 | -0.0008 | 0.0004 |
| 35 | -0.043 | 0.055 | -0.058 | 0.049 | -0.0001 | 0.0000 | -0.0002 | 0.0001 |
| 36 | -0.081 | 0.045 | -0.072 | 0.057 | -0.0003 | 0.0001 | -0.0003 | 0.0001 |
| 37 | -0.047 | 0.037 | -0.034 | 0.055 | -0.0001 | 0.0001 | -0.0001 | 0.0001 |
| 38 | -0.060 | 0.022 | -0.005 | 0.077 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 39 | -0.043 | 0.037 | -0.023 | 0.059 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 40 | -0.094 | 0.052 | -0.087 | 0.060 | -0.0006 | 0.0003 | -0.0004 | 0.0002 |
| 41 | -0.069 | 0.015 | -0.017 | 0.072 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 42 | -0.091 | 0.014 | -0.049 | 0.061 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 43 | -0.063 | 0.116 | -0.098 | 0.064 | -0.0005 | 0.0005 | -0.0005 | 0.0002 |
| 44 | -0.084 | 0.026 | -0.061 | 0.028 | -0.0003 | 0.0001 | -0.0002 | 0.0001 |
| 45 | -0.058 | 0.022 | -0.035 | 0.047 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 46 | -0.037 | 0.044 | -0.030 | 0.064 | -0.0002 | 0.0001 | -0.0001 | 0.0001 |
| 47 | -0.102 | 0.032 | -0.073 | 0.049 | -0.0005 | 0.0001 | -0.0004 | 0.0002 |
| 48 | -0.062 | 0.037 | -0.036 | 0.060 | -0.0002 | 0.0001 | -0.0001 | 0.0001 |
| 49 | -0.045 | 0.030 | -0.012 | 0.072 | -0.0001 | 0.0000 | -0.0001 | 0.0001 |
| 50 | -0.075 | 0.026 | -0.042 | 0.069 | -0.0002 | 0.0000 | -0.0001 | 0.0001 |
| 51 | -0.1052 | 0.0038 | -0.0665 | 0.0390 | -0.0004 | 0.0000 | -0.0003 | 0.0001 |
| 52 | -0.1080 | 0.0150 | -0.0760 | 0.0453 | -0.0003 | 0.0000 | -0.0004 | 0.0002 |

The correlation and the off diagonal elements of the var-cov matrix suggest that there is no significant measurement error.