# Online Appendix for

# "How Does Firm Scope Depend on Customer Switching Costs? Evidence from Mobile Telecommunications Markets"

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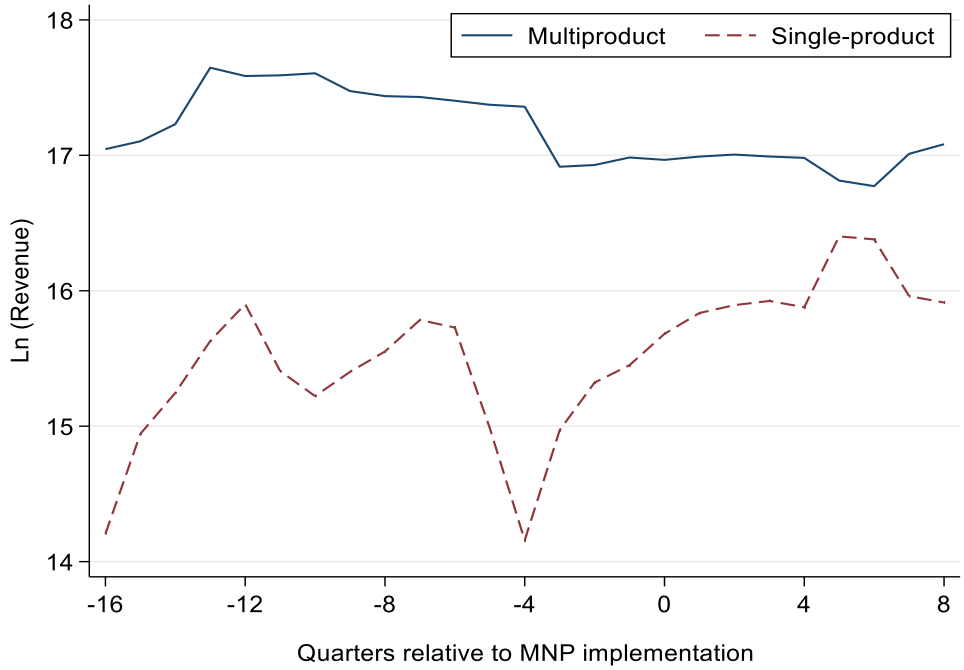
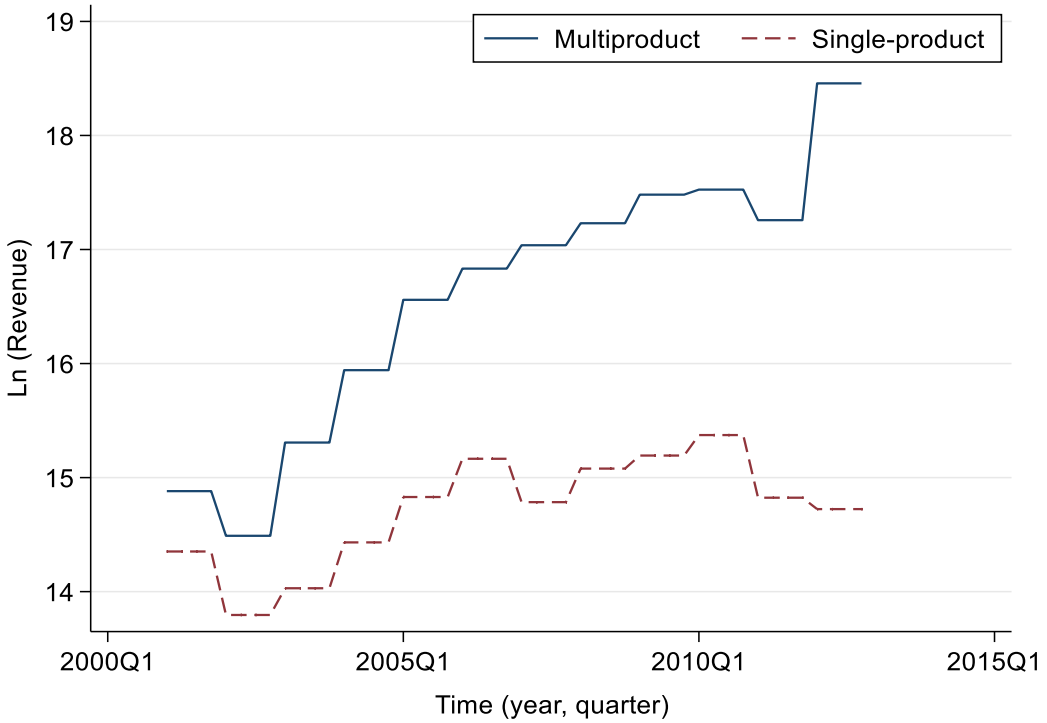
**Appendix Figure A1. Evolution of firm revenue before and after MNP**




*Notes.* The decrease in firm revenue 4 quarters before MNP implementation suggests the existence of a price war/ skirmishes between companies right before policy implementation. This effect is not observed after MNP implementation.

**Appendix Figure A2. Pre-policy revenue trend**




*Notes.* Graph shows Ln(Revenue) for single- and multiproduct firms over time only in countries that have yet to implement the policy. To avoid any anticipation effect, we excluded the two years prior to MNP introduction from the analysis.

**Appendix A. Internal Switching Rate of Multiproduct Firms**

For a subset of our sample, we have the following data for multiproduct firm *i* in quarter *t*: customers leaving postpaid services at firm *i*, customers leaving prepaid services at firm *i*, and customers leaving all services at firm *i*. Now, consider the following identity:

$$(1)\ Customers\ Leaving\ Postpaid_{it} =$$
$$Customers\ Leaving\ Postpaid\ and\ Firm_{it} + Customers\ switching\ to\ prepaid_{it}$$

The total number of postpaid disconnections for a firm is the sum of the total number of postpaid disconnections resulting in customers switching firms and the total number of postpaid disconnections resulting in customers switching to prepaid services of the same firm. Our goal is to isolate the last term of the above equation. We have data about the first term of the equation but unfortunately no information about the second term. However, we can derive it using the following equation:

$$(2)\ Customers\ Leaving\ Postpaid\ and\ Firm_{it} =$$
$$Customers\ Leaving\ Firm_{it} - Customers\ Leaving\ Prepaid\ and\ Firm_{it}$$

The above equation shows that the total number of postpaid disconnections resulting in customers switching firms is the difference between the total number of firm disconnections and prepaid disconnections resulting in customers switching firms. Building on equation (1), we can rewrite the last term of the equation (2) in the following way:

$$(3)\ Customers\ Leaving\ Prepaid\ and\ Firm_{it} =$$
$$Customers\ Leaving\ Prepaid\ _{it} - Customers\ switching\ to\ postpaid_{it}$$

Replacing (3) inside (2), and (2) inside (1), we can write:

$$(4)\ Customers\ Leaving\ Postpaid_{it} =$$
$$Customers\ Leaving\ Firm_{it} - Customers\ Leaving\ Prepaid\ _{it} +$$
$$Customers\ switching\ to\ postpaid_{it} + Customers\ switching\ to\ prepaid_{it}$$

Conveniently, we have data on all the above variables except for the last two. Thus, we can write the number of switching customers (in both directions between prepaid and postpaid) as the difference between the sum of prepaid and postpaid disconnections minus the firm's total disconnections:

$$(5)\ Switching\ Customers_{it} =$$

$$Customers\ Leaving\ Prepaid_{it} + Customers\ Leaving\ Postpaid_{it}$$

$$- Customers\ Leaving\ Firm_{it}$$

In relative terms:

$$(6)\ Internal\ Switching\ Rate_{it} =$$

$$Prepaid\ Churn\ rate_{it} \times Prepaid\ Share_{it} +$$

$$Postpaid\ Churn\ rate_{it} \times Postpaid\ Share_{it} - Churn\ rate_{it}$$

We derived this latter variable using the information available in the GSMA Intelligence dataset.

**Appendix Table I. Post hoc analysis: Alternative explanations (matched sample)**

| Variables | (1)<br>*Ln(Subscribers)* | (2)[a]<br>*Ln(Subscribers)* | (3)<br>*Ln(Subscribers)* | (4)<br>*Ln(Subscribers)* | (5)<br>*Ln(Subscribers)* | (6)<br>*Ln(ARPU)* |
|---|---|---|---|---|---|---|
| *PostMNP* | 0.639*** | 0.625*** | 0.651*** | 0.665*** | 0.626*** | 0.0834 |
| | (0.200) | (0.194) | (0.192) | (0.206) | (0.195) | (0.216) |
| *PostMNP × Multiproduct* | -1.095*** | -1.143*** | -1.147*** | -1.105*** | -1.144*** | 0.0442 |
| | (0.313) | (0.290) | (0.289) | (0.285) | (0.287) | (0.249) |
| *PostMNP × Market share* | -0.427 | | | | | |
| | (1.198) | | | | | |
| *Total Firms* | | 0.0219 | | | | |
| | | (0.0459) | | | | |
| *Total MVNOs* | | | 0.0135 | | | |
| | | | (0.0153) | | | |
| *Multiproduct MVNOs* | | | | -0.227 | | |
| | | | | (0.139) | | |
| *Single-product MVNOs* | | | | | 0.0212 | |
| | | | | | (0.0712) | |
| *HHI* | 0.000227* | 0.000238* | 0.000229* | 0.000226* | 0.000224* | -8.28e-05 |
| | (0.000122) | (0.000126) | (0.000122) | (0.000123) | (0.000128) | (6.45e-05) |
| *GDP* | -0.000506*** | -0.000459*** | -0.000704** | -0.000176 | -0.000586* | 0.000383*** |
| | (7.91e-05) | (0.000129) | (0.000268) | (0.000235) | (0.000301) | (6.38e-05) |
| *Population* | 0.0122*** | 0.0121*** | 0.0137*** | 0.0118*** | 0.0132*** | -0.00593 |
| | (0.00329) | (0.00327) | (0.00343) | (0.00328) | (0.00361) | (0.00400) |
| *Penetration* | 1.368** | 1.330** | 1.479*** | 0.995* | 1.409** | -0.973** |
| | (0.569) | (0.569) | (0.547) | (0.500) | (0.527) | (0.384) |
| Constant | 6.386*** | 6.171*** | 6.397*** | 6.396*** | 6.444*** | -8.28e-05 |
| | (0.985) | (1.017) | (0.986) | (1.002) | (0.998) | (6.45e-05) |
| Observations | 1,849 | 1,849 | 1,849 | 1,849 | 1,849 | 1,282 |
| R-squared | 0.751 | 0.751 | 0.751 | 0.754 | 0.751 | 0.687 |
| Number of IDs | 53 | 53 | 53 | 53 | 53 | 31 |
| Firm, Year & Quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |

*Notes.* Robust standard errors clustered at firm level are in parentheses.
[a]The results are similar if we exclude HHI from the regression model.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

**Appendix Table II. Post hoc analysis: Robustness analyses (whole sample)**

| Variables | (1)[a] *Ln(Subscribers)* | (2)[b] *Ln(Subscribers)* |
|---|---|---|
| *PostMNP* | 0.481** | 0.0534 |
| | (0.230) | (0.112) |
| *PostMNP* × *Multiproduct* | -0.793*** | -0.405*** |
| | (0.234) | (0.122) |
| *HHI* | -3.91e-05 | -4.17e-05 |
| | (3.46e-05) | (3.45e-05) |
| *GDP* | -0.000223*** | -0.000253*** |
| | (4.73e-05) | (5.06e-05) |
| *Population* | 0.0199*** | 0.0203*** |
| | (0.00252) | (0.00252) |
| *Penetration* | 1.417*** | 1.462*** |
| | (0.155) | (0.155) |
| Constant | 10.35*** | 10.33*** |
| | (0.307) | (0.307) |
| Observations | 17,162 | 17,162 |
| R-squared | 0.666 | 0.665 |
| Number of IDs | 380 | 380 |
| Firm FE | Yes | Yes |
| Year & Quarter FE | Yes | Yes |

*Notes.* Robust standard errors clustered at firm level are in parentheses. Model 1 shows the results of replicating in the whole sample while Model 2 uses a different multiproduct measurement. Results are consistent using random effects, country-level error clustering, and excluding controls (results available upon request).

[a] The results are consistent if we use error clustering at the country level as well as random effects and after excluding incumbents, identified as the first firm that launched a mobile network in each country.

[b] Single-product firms in Model 2 are defined as those located at the top and bottom 10% of the prepaid distribution before MNP. Conversely, multiproduct firms are located in between these values. If we classify single-product firms less strictly as those located at the top and bottom 20% of the prepaid distribution before MNP, the interaction term between *Multiproduct* and *PostMNP* becomes smaller (in absolute terms) and even insignificant (results available upon request). In other words, if we classify the choice of scope such that single-product firms are located only at the very extremes of the prepaid distribution, the performance difference between the two groups of firms becomes more pronounced after MNP.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.