

Pay it Forward (Digitally): Sizing up the Global Impact of Electronic Wages on Digital Payment Usage

Statistical Appendix

This statistical appendix presents modeling results referenced in the main analysis. The tables and figures contained in the appendix are described below:

- **Table A.1. Probit Selection (Adoption) Models:** Presents the results of the adoption models at the global and regional levels. The coefficients in A.1 do not represent marginal effects and should not be interpreted as magnitudes.
- **Table A.2: Usage Models:** These are the main models in the report and correspond to Figures 3 and 4. The coefficients in A.2 represent marginal effects. Table A.2 also contains the IMR coefficients. The Global model includes regional fixed effects. As discussed in the main analysis, the standard errors underlying these models are clustered by country. Additionally, note that the Heckman procedure calls for modeling cases in the second stage that had positive outcome variables in the first stage. Therefore, the sample sizes are lower than in the adoption models.
- **Table A.3: Interaction Effects between Electronic Wages and Employment:** Global usage model with interaction effects for electronic wages and employment. The coefficients in A.3 do not represent marginal effects and should not be interpreted as magnitudes. The coefficient on the interaction term between electronic wages and employment is positive and strongly statistically significant, indicating reinforcing effects between electronic wages and employment status. The constituent coefficient of interest, electronic wages, remains positive and statistically significant in the interaction model.
- **Table A.4: Alternative Versions of Dependent Variable:** Models 1 and 2 in Table A.3 replace the “Made Digital Merchant Payment” dependent variable from the main analysis with, respectively, “Used Debit Card In-Store” and “Used Mobile Phone to Pay for a Purchase In-Store.” In these models, individuals who receive electronic wage payments are about 11 percent more

likely to make payments using these specific forms of digital payments than those who do not receive wages electronically. The electronic wages variable is highly statistically significant.

- **Table A.5: Electronic Payment Acceptance Controls:** Models 1 and 2 in Table A.4 control for electronic payment acceptance (EPA) in individual economies. The electronic payments market is two-sided. Merchants' willingness to accept electronic payments affects consumers' usage of electronic payments, and vice versa. Measures of EPA are difficult to obtain. Model 1 proxies EPA by controlling for POS terminals per 100,000 adults from World Bank (2015). Model 2 uses an alternative measure, noncash payment transactions per 1,000 adults from World Bank (2015), as another proxy. Clearly these metrics are dated, but they are, to my knowledge, the best available EPA proxies at the country level. After 2015, the World Bank stopped publishing country-level results for these indicators. It now only publishes regional aggregates. The effects of electronic wages remain elevated in these models at around 13-15 percent. The effects are highly statistically significant. The EPA effects are very low and statistically insignificant. This could be due, in part, to the unit of analysis mismatch. The EPA variables are country-level, while the bulk of the analysis is individual-level.
- **Figure A.1: Distribution of digital payment usage by region:** Replicates Figure 1 in the main paper broken out by region.
- **Figure A.2: Digital merchant payment penetration as a function of electronic wages (by region):** Replicates Figure 2 in the main paper broken out by region.
- **Figure A.3: Marginal effects on likelihood of making digital merchant payments (One-stage, regional model):** Replicates Figure 5 in the main paper using a one-stage model. In the two-stage regional models, many of the IMR coefficients are insignificant. In the one-stage model, the electronic wages effects are stronger in five of eight regions and statistically significant in all eight regions, suggesting that it is prudent to lean on the two-stage model at the regional level.

Table A.1. Probit Selection Equations

| | Dependent Variable: Electronic Payment Instrument | | | | | | | | |
|---------------------------|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | Global* | EAP | ECA | HI-OECD | HI-Other | LAC | MENA | SAS | SSA |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Age: 30-44 | 0.292*** (0.011) | 0.431*** (0.035) | 0.231*** (0.030) | 0.254*** (0.051) | 0.188*** (0.053) | 0.275*** (0.029) | 0.473*** (0.036) | 0.388*** (0.038) | 0.191*** (0.022) |
| Age: 45-59 | 0.326*** (0.013) | 0.479*** (0.040) | 0.239*** (0.031) | 0.268*** (0.053) | 0.169*** (0.051) | 0.234*** (0.034) | 0.536*** (0.042) | 0.438*** (0.044) | 0.268*** (0.028) |
| Age: 60 and Up | 0.618*** (0.015) | 0.561*** (0.051) | 0.576*** (0.034) | 0.901*** (0.066) | 0.456*** (0.051) | 0.556*** (0.040) | 0.956*** (0.056) | 0.707*** (0.055) | 0.422*** (0.034) |
| Education: Secondary | 0.390*** (0.010) | 0.468*** (0.031) | 0.387*** (0.025) | 0.425*** (0.050) | 0.338*** (0.039) | 0.324*** (0.027) | 0.256*** (0.034) | 0.359*** (0.036) | 0.484*** (0.021) |
| Education: Tertiary | 0.832*** (0.019) | 1.176*** (0.061) | 0.808*** (0.039) | 0.494*** (0.063) | 0.803*** (0.074) | 0.825*** (0.044) | 0.878*** (0.053) | 0.729*** (0.096) | 1.007*** (0.080) |
| Sex: Female | -0.062*** (0.009) | -0.087*** (0.028) | -0.012 (0.023) | -0.002 (0.040) | -0.001 (0.035) | -0.130*** (0.024) | -0.277*** (0.033) | 0.088*** (0.034) | -0.063*** (0.019) |
| Employed | 0.290*** (0.010) | -0.067** (0.030) | 0.438*** (0.024) | 0.430*** (0.045) | 0.403*** (0.039) | 0.279*** (0.027) | 0.327*** (0.034) | 0.228*** (0.033) | 0.375*** (0.021) |
| Income: Second 20% | 0.090*** (0.014) | 0.051 (0.041) | 0.091*** (0.033) | 0.026 (0.055) | 0.183*** (0.046) | 0.064* (0.036) | 0.062 (0.047) | 0.070 (0.048) | 0.143*** (0.029) |
| Income: Middle 20% | 0.124*** (0.014) | -0.022 (0.042) | 0.158*** (0.034) | 0.173*** (0.058) | 0.254*** (0.051) | 0.076** (0.036) | 0.133*** (0.048) | -0.023 (0.048) | 0.211*** (0.029) |
| Income: Fourth 20% | 0.168*** (0.014) | 0.043 (0.044) | 0.247*** (0.035) | 0.258*** (0.061) | 0.280*** (0.054) | 0.129*** (0.037) | 0.145*** (0.048) | 0.048 (0.049) | 0.212*** (0.029) |
| Income: Richest 20% | 0.280*** (0.015) | 0.133*** (0.047) | 0.322*** (0.037) | 0.420*** (0.067) | 0.313*** (0.060) | 0.317*** (0.039) | 0.342*** (0.050) | -0.056 (0.052) | 0.351*** (0.030) |
| Internet Access | 0.528*** (0.012) | 0.644*** (0.036) | 0.506*** (0.031) | 0.200*** (0.061) | 0.756*** (0.047) | 0.610*** (0.029) | 0.017 (0.038) | 0.487*** (0.041) | 0.644*** (0.022) |
| Mobile Owner | 0.538*** (0.014) | 0.606*** (0.054) | 0.422*** (0.046) | 0.332*** (0.098) | 0.432*** (0.059) | 0.332*** (0.039) | 0.293*** (0.059) | 0.282*** (0.037) | 0.754*** (0.023) |
| Worried Age: Somewhat | 0.104*** (0.014) | -0.086* (0.046) | 0.240*** (0.032) | 0.190*** (0.055) | 0.269*** (0.046) | 0.107*** (0.038) | 0.105** (0.043) | -0.112** (0.054) | 0.037 (0.032) |
| Worried Age: Very | 0.104*** (0.015) | -0.322*** (0.052) | 0.231*** (0.038) | 0.127* (0.070) | 0.294*** (0.059) | 0.197*** (0.042) | 0.153*** (0.047) | 0.190*** (0.055) | 0.010 (0.030) |
| Worried Medical: Somewhat | -0.049*** (0.016) | 0.053 (0.049) | 0.057 (0.036) | 0.082 (0.057) | -0.096** (0.048) | -0.044 (0.043) | -0.099** (0.049) | -0.102 (0.064) | -0.158*** (0.037) |
| Worried Medical: Very | -0.112*** (0.017) | 0.014 (0.054) | 0.016 (0.040) | -0.055 (0.068) | -0.359*** (0.057) | -0.042 (0.046) | -0.230*** (0.052) | -0.149** (0.066) | -0.160*** (0.035) |
| Worried Bills: Somewhat | 0.004 (0.014) | -0.114*** (0.042) | -0.072** (0.031) | -0.085 (0.055) | -0.207*** (0.046) | 0.063* (0.038) | 0.032 (0.043) | 0.098* (0.054) | 0.141*** (0.029) |
| Worried Bills: Very | -0.080*** (0.015) | -0.200*** (0.048) | -0.135*** (0.037) | -0.028 (0.070) | -0.282*** (0.057) | -0.059 (0.042) | -0.186*** (0.048) | -0.013 (0.055) | 0.061** (0.028) |
| Constant | -1.041*** (0.025) | -0.742*** (0.075) | -1.346*** (0.058) | -0.350*** (0.114) | 0.076 (0.080) | -1.268*** (0.059) | -1.172*** (0.078) | -0.715*** (0.074) | -1.363*** (0.043) |
| Observations | 120,914 | 11,221 | 16,924 | 8,812 | 30,711 | 13,875 | 8,573 | 7,490 | 23,308 |
| Log Likelihood | -50,981.750 | -5,434.937 | -8,772.115 | -2,589.436 | -3,039.492 | -8,099.634 | -5,009.253 | -4,545.987 | -12,339.410 |
| Akaike Inf. Crit. | 102,017.500 | 10,909.880 | 17,584.230 | 5,218.872 | 6,118.984 | 16,239.270 | 10,058.510 | 9,131.974 | 24,718.810 |

Note:

*p<0.1; **p<0.05; ***p<0.01

* Global model includes regional fixed effects

Table A.2. Usage Models

| | Dependent Variable: Made Digital Merchant Payment | | | | | | | | |
|----------------------|---|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|---------------------|
| | Global* | EAP | ECA | HI-OECD | HI-Other | LAC | MENA | SAS | SSA |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Electronic Wages | 0.151*** (0.014) | 0.253*** (0.037) | 0.145*** (0.020) | 0.210*** (0.067) | 0.082*** (0.026) | 0.187*** (0.018) | 0.004 (0.015) | 0.085*** (0.024) | 0.194*** (0.020) |
| Age: 30-44 | -0.032*** (0.012) | -0.043 (0.045) | -0.059** (0.029) | -0.055 (0.036) | -0.035** (0.016) | -0.030 (0.028) | -0.101** (0.044) | -0.014 (0.019) | 0.014 (0.026) |
| Age: 45-59 | -0.074*** (0.016) | -0.043 (0.050) | -0.155*** (0.025) | -0.129*** (0.036) | -0.101*** (0.020) | -0.014 (0.038) | -0.123** (0.053) | -0.010 (0.011) | 0.015 (0.028) |
| Age: 60 and Up | -0.135*** (0.022) | -0.246*** (0.080) | -0.237*** (0.052) | -0.173** (0.080) | -0.142*** (0.036) | -0.023 (0.063) | -0.163** (0.073) | -0.043 (0.049) | -0.006 (0.059) |
| Education: Secondary | 0.065*** (0.023) | -0.123* (0.069) | 0.167*** (0.048) | 0.041 (0.065) | 0.095** (0.046) | 0.161*** (0.046) | 0.035 (0.023) | 0.066** (0.028) | 0.104* (0.054) |
| Education: Tertiary | 0.125*** (0.029) | -0.101 (0.084) | 0.242*** (0.077) | 0.031 (0.097) | 0.157*** (0.050) | 0.279*** (0.104) | 0.096* (0.056) | 0.138* (0.074) | 0.242*** (0.093) |
| Sex: Female | 0.006 (0.007) | 0.037*** (0.014) | 0.017 (0.013) | 0.070*** (0.024) | 0.004 (0.008) | -0.050*** (0.018) | -0.026 (0.025) | -0.047** (0.019) | 0.004 (0.012) |
| Employed | -0.021 (0.013) | -0.126*** (0.037) | -0.017 (0.039) | -0.031 (0.048) | 0.043*** (0.016) | 0.022 (0.038) | -0.029 (0.037) | 0.002 (0.027) | 0.021 (0.029) |
| Income: Second 20% | 0.021*** (0.007) | -0.025 (0.029) | 0.033 (0.024) | 0.038 (0.026) | 0.039*** (0.014) | 0.004 (0.031) | -0.061* (0.035) | 0.040 (0.029) | 0.024 (0.019) |
| Income: Middle 20% | 0.040*** (0.008) | -0.009 (0.026) | 0.055* (0.028) | 0.085** (0.042) | 0.066*** (0.017) | 0.043** (0.017) | -0.047 (0.034) | 0.036** (0.018) | 0.026 (0.031) |
| Income: Fourth 20% | 0.050*** (0.010) | -0.008 (0.055) | 0.078** (0.030) | 0.099** (0.046) | 0.063*** (0.018) | 0.089** (0.038) | -0.033 (0.035) | 0.088*** (0.027) | 0.015 (0.028) |
| Income: Richest 20% | 0.076*** (0.011) | -0.036 (0.061) | 0.111*** (0.031) | 0.106* (0.061) | 0.090*** (0.020) | 0.175*** (0.060) | 0.025 (0.035) | 0.132*** (0.021) | 0.020 (0.034) |
| Internet Access | 0.132*** (0.023) | 0.031 (0.067) | 0.159*** (0.041) | 0.292*** (0.046) | 0.180*** (0.053) | 0.199 (0.121) | 0.136*** (0.038) | 0.101*** (0.039) | 0.114** (0.054) |
| Mobile Owner | 0.100*** (0.026) | 0.067 (0.056) | -0.003 (0.057) | -0.053 (0.058) | 0.397*** (0.046) | 0.066 (0.056) | -0.012 (0.042) | 0.030 (0.025) | 0.041 (0.076) |
| IMR | -0.126** (0.056) | -0.533*** (0.200) | -0.146 (0.154) | -0.227 (0.290) | 0.364 (0.228) | 0.106 (0.231) | -0.123 (0.103) | -0.073 (0.081) | 0.017 (0.131) |
| Constant | -0.258 (0.355) | 1.335* (0.741) | -0.544 (0.530) | -0.790 (0.710) | -1.922*** (0.294) | -1.716 (1.217) | -0.618 (0.705) | -1.848*** (0.447) | -1.421** (0.664) |
| Observations | 90,772 | 8,502 | 12,544 | 8,083 | 30,158 | 8,816 | 4,054 | 4,510 | 14,105 |
| Log Likelihood | -49,154.720 | -3,840.822 | -6,797.596 | -4,630.497 | -18,803.130 | -4,810.312 | -1,463.966 | -1,293.811 | -6,510.494 |
| Akaike Inf. Crit. | 98,355.440 | 7,713.643 | 13,627.190 | 9,292.994 | 37,638.260 | 9,652.624 | 2,959.932 | 2,619.623 | 13,052.990 |

Note:

*p<0.1; **p<0.05; ***p<0.01

* Global model includes regional fixed effects

EAP (East Asia & Pacific); ECA (Europe & Central Asia); HI-OECD (High Income OECD); HI-Other (High Income Non-OECD); LAC (Latin America & Caribbean); MENA (Middle East & North Africa); SAS (South Asia); SSA (Sub-Saharan Africa)

Categorical variable baselines: Age (15-29); Education (Primary or less); Income (Poorest 20%)

Table A.3. Electronic Wages and Employment Interaction Effects

| Dependent Variable: Made Digital Merchant Payment | |
|---|----------------------|
| Electronic Wages | 0.209*** (0.060) |
| Employed | -0.137*** (0.050) |
| Age: 30-44 | -0.101*** (0.033) |
| Age: 45-59 | -0.226*** (0.044) |
| Age: 60 and Up | -0.423*** (0.063) |
| Education: Secondary | 0.181*** (0.066) |
| Education: Tertiary | 0.347*** (0.083) |
| Sex: Female | 0.015 (0.020) |
| Income: Second 20% | 0.057*** (0.022) |
| Income: Middle 20% | 0.111*** (0.024) |
| Income: Fourth 20% | 0.141*** (0.029) |
| Income: Richest 20% | 0.216*** (0.033) |
| Internet Access | 0.375*** (0.070) |
| Mobile Owner | 0.284*** (0.078) |
| IMR | -0.423** (0.165) |
| Electronic Wages:Employed | 0.293*** (0.077) |
| Constant | -0.156 (0.359) |
| Observations | 90,772 |
| Log Likelihood | -49,092.420 |
| Akaike Inf. Crit. | 98,232.830 |

Note: *p<0.1; **p<0.05; ***p<0.01

Note: Model includes regional fixed effects

Table A.4. Alternative Versions of Dependent Variable

| | Made In-Store Purchase Using: | |
|----------------------|-------------------------------|----------------------|
| | Debit Card (1) | Mobile Phone (2) |
| Electronic Wages | 0.111*** (0.017) | 0.110*** (0.011) |
| Age: 30-44 | 0.006 (0.012) | -0.055*** (0.011) |
| Age: 45-59 | -0.009 (0.014) | -0.118*** (0.016) |
| Age: 60 and Up | -0.037* (0.020) | -0.196*** (0.019) |
| Education: Secondary | 0.041* (0.023) | 0.028 (0.022) |
| Education: Tertiary | 0.039 (0.030) | 0.094*** (0.027) |
| Sex: Female | 0.013** (0.006) | -0.005 (0.006) |
| Employed | -0.050*** (0.012) | -0.003 (0.012) |
| Income: Second 20% | 0.001 (0.007) | 0.016** (0.007) |
| Income: Middle 20% | 0.010 (0.008) | 0.036*** (0.007) |
| Income: Fourth 20% | 0.020** (0.009) | 0.041*** (0.008) |
| Income: Richest 20% | 0.037*** (0.013) | 0.072*** (0.008) |
| Internet Access | 0.071*** (0.023) | 0.112*** (0.023) |
| Mobile Owner | 0.008 (0.031) | 0.112*** (0.023) |
| IMR | -0.283*** (0.065) | -0.051 (0.046) |
| Constant | -0.471 (0.329) | -0.609 (0.383) |
| Observations | 90,751 | 90,709 |
| Log Likelihood | -40,563.790 | -44,106.640 |
| Akaike Inf. Crit. | 81,173.580 | 88,259.270 |

Note: *p<0.1; **p<0.05; ***p<0.01

Note: Models include regional fixed effects

Table A.5. Electronic Payment Acceptance (EPA) Controls

| EPA Control: | Dependent Variable: Made Digital Merchant Payment | |
|----------------------|---|----------------------|
| | POS Terminals | Noncash Transactions |
| | Per 100K Adults | Per 1K Adults |
| | (1) | (2) |
| Electronic Wages | 0.148*** (0.018) | 0.132*** (0.017) |
| Age: 30-44 | -0.066*** (0.011) | -0.057*** (0.015) |
| Age: 45-59 | -0.103*** (0.016) | -0.099*** (0.019) |
| Age: 60 and Up | -0.177*** (0.027) | -0.186*** (0.026) |
| Education: Secondary | -0.001 (0.032) | 0.024 (0.023) |
| Education: Tertiary | 0.014 (0.043) | 0.068** (0.035) |
| Sex: Female | 0.019** (0.008) | 0.009 (0.008) |
| Employed | -0.061*** (0.018) | -0.037** (0.016) |
| Income: Second 20% | 0.011 (0.008) | 0.031*** (0.008) |
| Income: Middle 20% | 0.017* (0.010) | 0.045*** (0.010) |
| Income: Fourth 20% | 0.028** (0.013) | 0.059*** (0.013) |
| Income: Richest 20% | 0.041** (0.016) | 0.084*** (0.015) |
| Internet Access | 0.060** (0.026) | 0.110*** (0.031) |
| Mobile Owner | 0.072** (0.037) | 0.093** (0.039) |
| IMR | -0.600*** (0.105) | -0.376*** (0.109) |
| EPA Control | 0.000 | -0.000 |
| Constant | 0.970** (0.493) | 0.396 (0.445) |
| Observations | 62,487 | 62,615 |
| Log Likelihood | -34,045.960 | -34,342.430 |
| Akaike Inf. Crit. | 68,139.910 | 68,732.860 |

Note:

*p<0.1; **p<0.05; ***p<0.01

Note: Models include regional fixed effects

Figure A.1: Distribution of Digital Payment Usage by Region

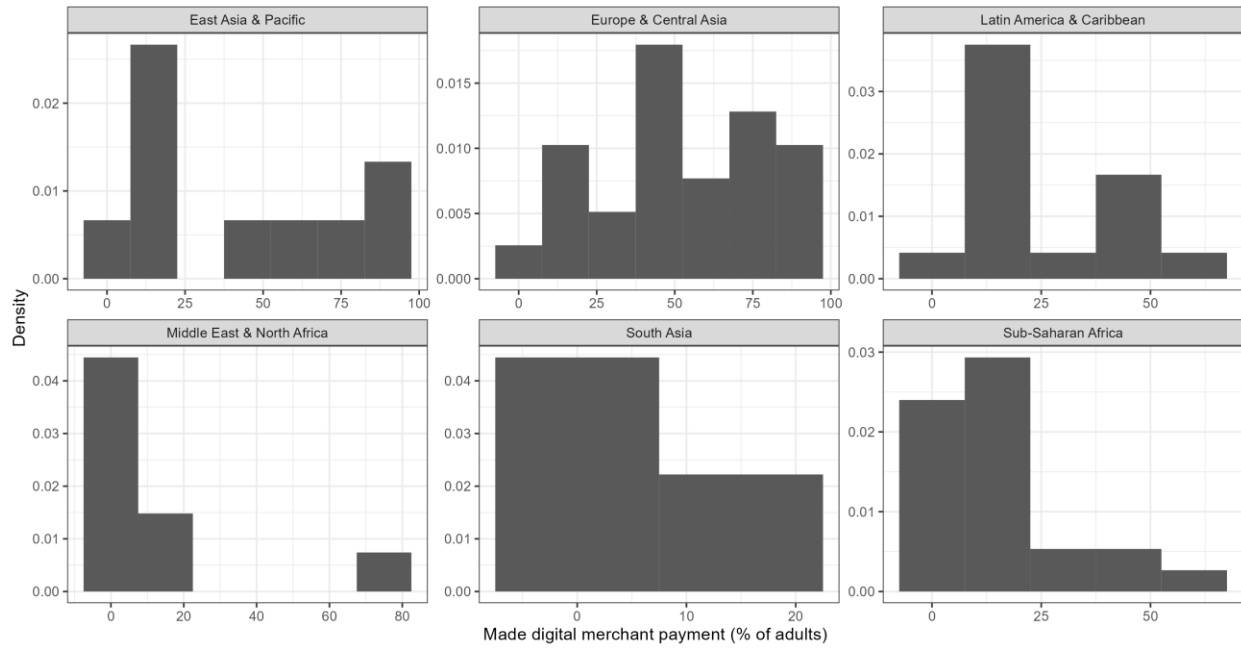
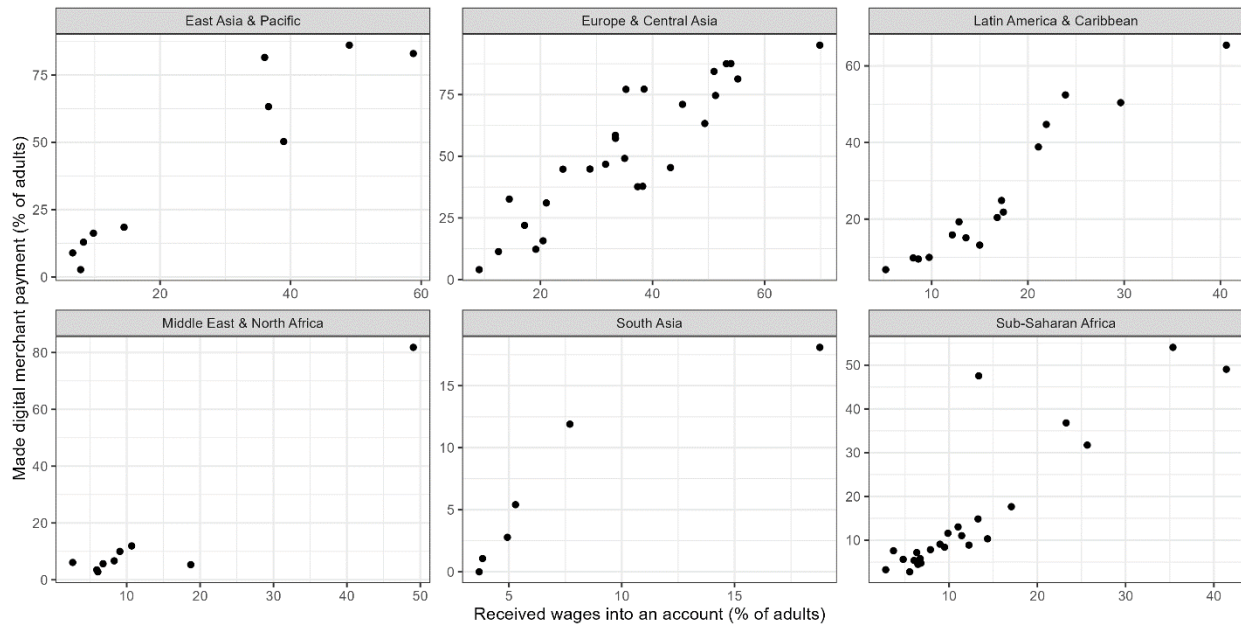
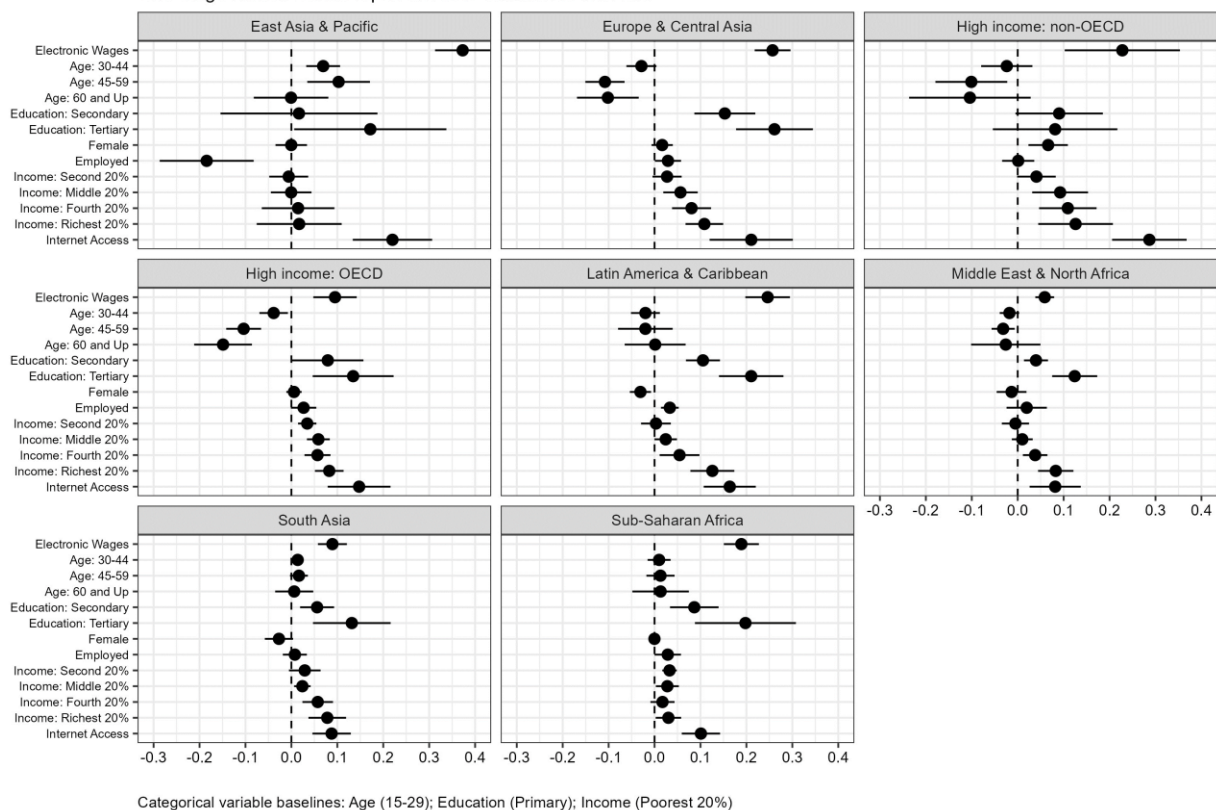


Figure A.2: Digital merchant payment penetration as a function of electronic wages (by Region)



Source: World Bank Global Findex Database (2021)

Figure A.3: Marginal effects on likelihood of making digital merchant payments
One-stage model. Bands represent 95% confidence intervals



References

World Bank. 2015. Global Payments Systems Survey. Retrieved from World Bank DataBank, G20

Financial Inclusion Indicators. <https://datatopics.worldbank.org/g20fidata/>.