

Pachis, Athanasios; Yannelis, Demetrius

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The relation between local loop unbundling and investment in fixed telephony

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The relation between local loop unbundling and investment in fixed telephony.

Executive Summary.

Telecommunications play an increasingly important role in the world economy. Many studies have highlighted their importance in the development of an economy. For instance (Fornefeld, Delaunay, and Elixmann 2008) highlight their strong positive effect in employment, productivity and GDP in all sectors of the economy. In this study we try to investigate the importance of regulation in investment in fixed telephony. We try to achieve this through econometric modeling of the price of the Local Loop unbundling in the share of alternative access infrastructure. We use panel data from 12 countries for a period of 8 years. Our conclusion is that the price of the LLU has a positive relationship on the share of alternative access infrastructure. Therefore it is suggested that all else equal a higher price would result on an increase in the share of alternative infrastructure.

Introduction

During the last couple of years it has been made apparent that the supply of advanced telecommunication services, such as for example high definition video, requires the development of new technologies and infrastructure. However after the bursting of the new technology boom bubble, investments in fixed networks in EU have been declining until 2004 (Cave, 2006). The small increase since 2004 has not been able to reach the initial high levels of investment. Moreover in many countries of the EU, the development of competitive telecommunication infrastructure, that would facilitate investment (Huigen, and Cave, 2008), has not been realized yet.

In these not optimal conditions, the importance of defining an optimal regulatory framework that would facilitate a level of investments that maximize social welfare is of primary importance. In this respect worldwide

regulators, recognizing the criticality of the problem, have started to revise their regulatory frameworks.

The most critical factor that affects the regulatory framework is the relation between the dynamic and static efficiency. Thus the relationship between the requirement for introduction of competition that facilitates the use of resources efficiently and promotes investment, and the requirement for providing incentives that reduce the production cost.

In the beginning of the deregulation of the telecommunications market, where the prospect of competition was far off, it was expected that the relevant literature would concentrate on an application of regulatory framework that would provide the necessary incentives for the incumbent to make investments that reduce the production cost. Thus the theory of price caps and that of regulatory clearance for a period of time as superior in terms of incentives to reduce the production cost as the previous return on investment regulation. The above statement was supported by relevant studies such as (Cabral and Riordan, 1989), (Biglaiser and Riordan 2000)

However the introduction of completion that resulted in the retail market from the requirement of the incumbent to provide access to competitors in its' network had as a consequence that the relevant literature focused in the effect that the access price had on total investments in telecommunication networks.

The requirement of the monopoly to provide access to its' network to competitive carriers was determined necessary by regulators for the introduction of competition in the retail market without the requirement of developing costly parallel networks. It is assumed by some that this is the necessary first step in order for the carriers to enter the market and gain critical know-how before they invest in their own networks. The theory that mostly supports this approach is the ladder of investment of Cave (Cave and Vogelsang, 2003) However the theory of the ladder of investment has been criticized by other authors.

It was Laffont and Tirole (Laffont και Tirole, 2000) that first suggested that an inverse relationship exists between providing access to facilitate

competitive entry and providing the necessary incentives for the telecommunications companies to develop their own networks. It is suggested that access price regulation increases static efficiency by facilitating entry and thus reducing the incumbents' market power, resulting in lower prices and more consumer surplus for the consumers. Competition also disciplines producers for inefficient use of inputs and thus provides incentives for lower production costs. However it also provides disincentives for investments in existing or developing networks by reducing ex-post rents for the telecommunications companies, thus lowering dynamic efficiency. This inverse relationship in models of monopolistic competition and product differentiation is called the Schumpeterian effect in the literature.

However recent studies have suggested that a more complex relationship exists and is characterized by an inverted U relationship (Friederiszick, Grajek and Röller, 2008). In the beginning of competitive entry at relatively low levels of competition an increase in competition would enhance investment in networks and new products and thus facilitate innovation. This effect is called the escape effect in the literature where it occurs when competition reduces a firm's pre-innovation profits by more than it reduces its' post-innovation rents. However after a certain level of competition increased competition would result on the Schumpeterian effect of lowering innovation. The exact figure that characterizes the relationship in any telecommunications market would be expected to be determined by the existing level of competition, the demand for new products as well as how far are the carriers from the technological frontier and thus the cost of innovating. Thus the exact nature of the relationship would be affected by market specificities.

Literature Review.

In their effort to examine this relationship many studies have been committed using theoretical models as well as empirical research often with conflicting conclusions.

Jorde et al (Jorde et al.2000) using a financial investment model concluded that forced unbundling of the local loop with prices based on future costs

results in disincentives for investment in the maintenance and expansion of the network for the incumbent. In addition it drives competitive carriers in non-socially optimal level of investment. The forced access that the incumbent has to supply to competitive carriers reduces the future worth of the investment, especially if it is based on future costs, and acts as a disincentive. In support of the above (Valeda 2007) finds that unbundling decreases the incentives of the incumbent to invest in infrastructure upgrades but also increases the incentives to invest in cost reducing with the overall effect to be uncertain.

In contrast (De Bijl and Peitz 2007) supported that if the access price is set at sufficiently high levels after the new investment in quality or capacity then the incentive for the firms to invest increases. Similarly (Avelani, Matteucci, and Reverberi 2008) conclude that an access price that rises since entry into the market can result in a socially optimal level of investment by competitive carriers. They also conclude that the appropriate regulator should set the access price not only in respect to the time period since entry but also on the entry period since each entrant to be faced with the same entry conditions. The above papers seem to agree with the theory of the ladder of investment where an optimally set access price after entry can foster investment in new infrastructure. The initial relatively low access price facilitates competitive entry in the retail market, while the rising access price affects the make or buy decisions of the competitive carriers and gives them the necessary incentives to invest in new infrastructure. In contrast as it concerns the effect of local loop unbundling in the investments of competitive firms (Bourreau and Dogan 2005) conclude that in comparison to an unregulated industry, the competitive carriers ability to lease lines at regulated prices delays their investment into new infrastructure. The future value of the investment for the competitive firm decreases as the opportunity cost rises since it can gain access at reduced cost.

One factor that has been highlighted by the relevant literature that may result in a negative relationship between local loop unbundling and investment is the asymmetry of risk that exists between the incumbent and the competitor operators. For example investment on new product and services entails uncertainty about the level of demand and as a result of

revenue that increases a firm's cost of capital. Since this cost is usually not incorporated in the access price after the investment it reduces the value of the investment for the incumbent carrier. In contrast competitive firms can observe market conditions after the investment and enter the market without facing that risk. For example (Pindyck 2007) use an Efficient Component Pricing Rule methodology in order to compensate the incumbent for the asymmetric risk. He incorporates an option to delay value so as to make the entrants' expected earnings equal to zero. At that value the incumbent would be indifferent between providing access to entrants and providing the retail service itself. In contrast (Camacho and Menezes 2009) argue that an access charge set equal to the difference between the maximizing-welfare retail price cap and the incumbent's marginal cost at each period, results in a higher social welfare than the ECPR. Access charges are equal or lower than ECPR, while ECPR prices leave full monopoly rents to the incumbent.

Except the asymmetric risks faced in the demand side by the incumbent and entrants another source of uncertainty for the prospective investor is the regulatory risk. That is the limited capability of the regulator to make a credible ex ante commitment that the regulating environment would remain the same during the depreciation of the investment. For example the regulator has an incentive to lower the price cap or the access price once the investment has occurred in order to increase social welfare. The limited ability of the regulator to credibly commit to a price scheme lowers the investment value for the investor and acts as a disincentive for investment. If such commitment cannot be ensured the ability of the firm to enhance demand by offering value added products and services will affect substantially the investment decision (Fors 2004). Similarly (Brito, Pereira, & Varela 2007) argue that in conditions of non-credible regulatory commitment investment would occur only for low investment cost or high product differentiation, which allows the investment firm to earn significant profits in a competitive environment. Thus in both these papers the investment decision would be significantly affected by the ability of the investment firm to escape competition (escape effect)

In order to overcome the problem of regulatory commitment a number of regulatory schemes have been considered. One of those is the allowance to

the investment firm of a regulatory holiday. That is a period free of regulatory revision that a firm can recoup its' investment costs. (Gans and King 2002) confirm the effectiveness of the regulatory holiday in moving forward the time period of the investments as it allows for an investment firm to recoup its' costs. Another instrument that has been used in order to counteract the regulatory risk is the sunset clause. That is a period determined ex ante after which the firms' facilities are not regulated. However (Bourreau and Dogan 2005) argue that it acts as a disincentive for the entrant to build its' own facilities and does not improve social welfare. (Blum, Growitsch, and Krap 2007) consider that in conditions of asymmetric information a regulatory threat to intervene via an ex ante signal may be better for investment incentives than an actual regulatory intervention. (Evans, Levine, and Trillas 2008) stress the importance of a fully independent and sufficiently pro industry regulator in reducing regulatory risk and thus allowing for a socially optimal level of investment. (Hori and Mizuno 2009) concentrate on the decision of the firms to compete on services based competition or in facilities based competition. They conclude that when the entrant has access to the incumbents' network then the decision to invest in its' own network is delayed. In regard to the incentives of the incumbent to invest they conclude that when uncertainty is high, facilities based competition speeds up the investment in alternative infrastructure than services based competition

It is clear that the research based on theoretical models does not have clear policy implications for the regulator about the best regulatory framework to promote investments in new infrastructure. This is due to the conflicting results of this research that maybe caused by the different theoretical assumptions this research is based on as well as the complex nature of the relationship.

Due to the ambiguity of the theoretical research many researchers focused in empirical based studies in order to clarify the nature of this relationship.

(Ford and Spiwak 2004) using data from the USA telecommunications market in the period from 2001 to 2003 conclude that the setting of the access price according to the future costs of the incumbent has a positive

impact on broadband services in general and increased availability of competitors' broadband services specifically. Moreover (Wilig 2006) using econometric techniques show that a relative small decrease of the access price has as a consequence a significant increase in the incumbent investments. (Christodoulou και Vlachou 2001) using industry simulation technique conclude that a mixture of service based and facilities based competition combined with an increasing access price has a positive impact both on the incumbent and competitors investments. In contrast (Chang et al 2003) analyzing data from the telecommunication market of several European countries conclude that are indicators that lower access prices lead to an overall increase in investments. Moreover in studies that analyze the factors that affect investment in general, (London Economics 2006) using data from the telecommunications markets of all countries of the EU conclude that except factors such as macroeconomic indicators, technological developments, the investment cycle etc. highlight the importance of optimal pricing of the local loop unbundling. (Wallsten 2006) studying the relationship between access price, demography and the growth of broadband when different levels of unbundling are used. He concluded that more advanced unbundling schemes have a negative impact on investment incentives but alternative schemes can have a positive impact on the incumbent incentives.

In contrast (Ingraham and Sidak 2003) using econometric techniques analyzing data from the USA telecoms market argue that forced local loop unbundling leads to asymmetries of risk and cost of capital between the incumbent firm and the competitors. Moreover (Crandall and Singer 2003) argue that the unbundling of local loops and the regulation of access price has a negative impact on investments.

Other studies criticize the setting of the access price according to future costs that do not permit the recoupment of the irreversible costs of a firm's investment. For example (Hausman et al 1997) and (Pindyck 2007) focusing on the USA telecommunication market support that the setting of access prices based on future costs. Result in disincentives for investment for the incumbent firm. Similarly (Crandall et al. 2004) analyzing again data from the USA telecoms market in order to assess the theory of ladder of

investment conclude that investment in new broadband lines decreases for relatively low access prices. In addition (Jung et al 2008) support that there are no sufficient evidence for a positive relation to exist between the forced local loop unbundling and the promotion of incentives for investment in new infrastructure. Moreover (Hazlett και Bazelon 2005) conclude that the lines leased from the incumbent firm are negatively associated with the lines owned by the competitive firms.

Additional studies performed in the European market have similar conclusions. For example (Waverman et al 2007) ,using an econometric model based on a hypothetical country representative of the 15 EU countries, argued that even a small relative decrease of the access price of 10% has a significant negative impact in the market share of alternative networks in the market of broadband services. In a more extensive study (Friederiszick et al 2008) using data from 25 European countries show that the unbundling of the local loop has a negative effect on the investments of the competitive carriers on new fixed telecom lines

Finally (Wallsten και Haustaden 2009) study the effect that local loop unbundling has on the choice of the network technology by the incumbent firm. They show that there is a negative relationship between unbundled DSL lines and investment in optical fiber lines.

The Econometric Model.

The econometric model relates to that of (Waverman et al 2007). However the econometric model that we have used differs in the use of some different variables as well a different methodology. Our goal in measuring the relationship between the regulation and investment is to provide more robust econometric analysis due to the fact that more data available to us as well as use a different econometric analysis. Like the econometric analysis of (Waverman et al 2007) the model tries to minimize its' use on qualitative variables such as scorecards, indexes and additionally tries to minimize its' reliance on data that are estimated. In only one variable, we have used extrapolating techniques as terms necessary in order to provide more robust econometric analysis. Moreover one variable that we have used in the econometric analysis is in the form of index.

The data that we have used is as much as possible directly observable and simple such as for example number of subscribers for both incumbent and entrants prices for the local loop unbundling and cost related variables like internet penetration versus internet readiness of cable plant.

We have used a proxy for a variable that were not directly observable such as cost the based variable. However the proxies that we have used like that of (Waverman et al 2007) are not based on estimation but rather are directly observable from major telecommunication publications. Rather all data that we have used in the econometric analysis come from major telecommunication publications.

The model is constrained by the data that was available to us. Rather than acquiring disaggregated data that would be ideal in order to capture the impact of regulation in investment the model uses aggregated data. Disaggregated data are very difficult to acquire and only a few studies have utilized them, often in some sort of agreement with the regulator or the providers.

Thus we model the impact of access prices on the share of broadband lines offered by alternative means infrastructure other than the traditional DSL lines offered by incumbents' network.

The analysis as in (Waverman et 2007) uses data on subscribers' lines rather than the ideal direct data in investment in plants that were unavailable to us.

The justification for that is that current and planned capital expenditure in facilities based infrastructure is depended to the current and expected subscriber demand over that infrastructure (Waverman et 2007).

For instance, in theory, if regulators increase the price of the local loop unbundling in order to stimulate facilities based competition this would increase the input costs of the LLU option while the input costs of the alternative facilities access option will remain the same. Thus it will become easier for the alternative facilities access operators to increase their market share. The alternative access operators would be more likely to upgrade and further expand their network would have possibly have higher capital costs with serving new customers (Waverman et 2007).

The Data

Table 1 provides the main explanation of the variables used in the econometric analysis as well as the sources of the data provided.

Table 1

Variables	Description	Source
Share_Alternative Access	Share of sum of all broadband lines offered through alternative access infrastructure — this includes competitor and incumbent cable, all fibre, WiMax, WiLL, and competitor DSL offered over alternative networks, excludes WIFI	COCOM— Communications Committee of DG Infosoc, July 2007, July 2009
LLUprices	Annual price for a fully unbundled local loop in Euros.	Implementation of the Telecommunications Regulatory Package Report 8 th to 15 th .
LLU Years	Years since LLU was first implemented in each country.	OECD Communications Outlook 2005
Ratio	Ratio of total Internet penetration households to internet-ready cable plant in 2003 and 2006.	OECD Communications Outlook 2005 and 2007 Eurostat
GDP	GDP in real prices of the relevant countries with 2005 as the base year.	OECD statistical database.
Regulatory Reform Index	The RRI includes a range of indicators that measure the extent that these policy settings prohibit or enhance competition in the telecommunications market.	OECD statistical database.
HHI_intra	Hirschman-Herfindahl Index computed from	COCOM— Communications

	the shares of incumbent and entrants DSL offered through the incumbent network to the total DSL Broadband	Committee of DG Infosoc, July 2007, July 2009. Calculated
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The data that we have used covers the years from July 2002 to July 2009. The analysis includes data from 12 European Countries that entered the EU before 2002. It does not include the accession states that entered in 2004 as for many of them data are available for 2004 and onwards. The countries that are included in the analysis are namely Austria, Belgium, Denmark, Germany, Spain, Finland, France, Italy, Netherlands, Portugal, Sweden, and the United Kingdom. The data that where available describe the number of subscriber lines differentiated between incumbent and entrant and for each access technology.

The data for the alternative access variable where available on a semi-annual basis. Namely for January and July each year. The data for the price of the LLU where available on an annual basis, namely for October each year. Therefore I have assumed that the price of the LLU remains the same per year for each observation of the above variables. The same holds for the variables GDP and Regulatory Reform Index. That is that GDP and the regulatory environment remain the same during each year.

The whole dataset includes data drawn from 12 countries for a period of eight years. The data are in a form of a panel. Panel data are more able than cross sectional or time series data to control for individual unobserved heterogeneity among countries. Moreover are more informative, provide for more variability, less collinearity and provide more degrees of freedom. They allow to study dynamic individual effects and thus to construct and test more complicated and more informative econometric models.

The Model.

Our study tries to capture the effect of a change in the price of LLU in the share of alternative access infrastructure. Thus the substitution effect between broadband based on LLU and broadband based on alternative access technologies.

In order to achieve that we estimated an equation that addresses the substitution effect by explaining the shares of different access technologies as a function of the LLU price.

$$\text{LOG}(\text{share_ALTERNATIVEACCESS}_{it}) = C(1) + C(2) * \text{LOG}(\text{LLUPRICE}_{it}) + C(3) * \text{LOG}(\text{RATIO}_{it}) + C(4) * \text{GDP} + C(5) * \text{LLUYears} + C(6) * \text{RRI} + C(7) * \text{Lag HHI_intra}$$

The equation models the share of alternative access technologies as a function of the price of the LLU and a proxy for the incremental cost of using these alternative access technologies.

The variable Ratio as used in (Waverman et al 2007), is a proxy for the incremental cost of serving additional subscribers via cable television networks. When the ratio is high then the incremental cost is high to serve additional subscribers because there is either no existing cable plant to serve them or the existing cable plant is insufficient in order to serve them. Thus cable television network needs to be expanded in order to serve the additional demand making the incremental cost relatively high. When the ratio is low then the incremental cost is relatively low because the existing cable plant is sufficient to serve additional subscribers. There is no need to expand the cable television network because additional subscribers subscribe to the plant that passes through their area. The variable Ratio uses data for internet ready cable plants because data from other alternative access

technologies are unavailable and also cable is by far the most utilized alternative access technology.

The variable LLUYears is introduced in order to capture the experience effect for each country. For example a country that first utilized LLU earlier than another country has gained more experience in utilizing the LLU (for example in marketing, cost control of other factors e.t.c) and is expected to have higher percentage market share of LLU lines all other ceteris paribus. However this experience effect is expected to have diminishing returns as time passes by. For example the market familiarity effect is expected to be larger for a country that introduced LLU 10 years ago than from a country that introduced last year comparing to the same country than a country that introduced it 20 years ago (Waverman et al 2007).

The variable GDP is introduced in order to capture the effect of the overall level of the economy in the share of the alternative access technologies. For instance a growing economy has a consequence a higher demand for telecommunication services. Thus it results in a increased level of investment in existing and alternative telecommunications infrastructure. This applies especially to alternative technologies such as Fiber, where the costs are high but the also the added value is high.

The variable Regulatory Reform Index relates to the stability and effectiveness of the regulatory environment in each country. Economic theory suggests that investors in order to invest in infrastructure require regulatory stability and a healthy regulatory environment in order to gain their projected return on investment. As investments in infrastructure usually take many years, investors require protection from arbitrary regulatory decisions or sudden changes in regulatory policy and market conditions. The telecommunications sector of the RRI has three main subsections. Namely a) entry regulation, b) public ownership and c) market structure that are evaluated according to eight criteria. Each country receives a weighted score on how it performs along those eight criteria in each of the three subsections. The countries that have overall the best regulatory environment receive the lower score and the countries with the worse regulatory environment receive the higher score in a range from 0 to 6.

The variable HHI_intra relates to the degree of market share concentration and competition in the broadband DSL market in each country. Economic theory suggests that a lower HHI_intra value means a higher level of competitiveness in the broadband DSL market which has as an effect an increase in the share of DSL lines offered through the incumbent network through increased investment in the network. Increased investment occurs because increased competition results in an increase in static efficiency. However Cave, Cave (2006), suggests that increased competition in one access technology also enhances infrastructure competition through the ladder of investment. So it would be interesting to see what result has increased competition in one access technology, that is the incumbent network, to the overall share of alternative access technologies.

We use the lagged values of the HHI_intra variable because it is potentially determined contemporaneously with the share of the alternative access technologies. Therefore it is potentially correlated with the error term.

Econometric Analyses.

In our econometric analyses we use Fixed Effects in order to assess the relationship between the independent variables and the depended variable. Each country has its' own individual characteristics such as political system or business environment that may influence for example the regulatory environment or the level of investment in each country. Thus with using Fixed Effects we assume that something within the individual countries may influence the depended or independent variables and we need to take account of that. Thus we assume that the country specific error, which remains constant over time, and the independent variables are correlated. Fixed effects remove the effect of those time constant country specific characteristics from the independent variables so that the estimated coefficients are not biased due to the omission of time invariable country specific characteristics.

Results of the Regression Analysis.

Table 2 shows the results of the regression analysis of the equation. It shows the regression coefficients along with their statistical significance. Some of the variables in the regression are transformed to natural logs. The reason for this transformation is that coefficients in this log to log transformation are regarded as elasticities. The standard errors are robust because we run the Modified Wald test for groupwise heteroskedasticity for fixed effects and we identified its' presence.

Table 2. Results of the Regression

Variable	Coefficient	Robust Stand. Err.	t value	P value
Log(share_alternative access)				
Constant	-6.031544	1.236406	-4.88	0.001
Log(LLUPrice)	0.5659044	0.2518392	2.25	0.048
Log(Ratio)	-0.6416358	0.1002552	-6.40	0.00
LLUYears	-0.0525963	0.0540766	-0.97	0.354
RRI	0.3121772	0.211597	1.48	0.171
GDP	0.0000614	0.0000428	1.43	0.182
lagHHI_intra	0.3487585	0.4764865	0.73	0.481
Diagnostics				
F-Statistic	671.24			0.00
Overall Adj. R-squared	0.4314			

Modified Wald test	533.50	Prob>chi2 = 0.00
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The coefficients of the regression have the following interpretation.

- The coefficient or the elasticity of the price of the LLU to the share of alternative access is approximately 0.566. It is significant at a 5% level. The P value indicates that there is 0.48% we observe this value when actually the coefficient is zero. The elasticity of 0.566 means that a decline of 10% in the value of the price of LLU will result in a 5,66% increase in the share of alternative access infrastructure.
- The coefficient or the elasticity of the ratio variable is approximately -0.64 and is highly statistical significant at a 1% level . The negative value of the coefficient concurs with the design of the variable as a proxy of the incremental cost of expanding the cable television network. Thus a 10% increase in the value of the ratio would result in a 6.4% decrease in the share of alternative access.
- The coefficient of the variable LLUYears is approximately -0.053. The sign of the coefficient shows that it has an inverse relationship to the share of alternative access as it has a positive effect on the share of the DSL lines passing through the incumbent established network. However the coefficient is not significant even at a 10% level and therefore does not statistically differs from zero.
- The coefficient of the variable Regulatory Reform Index is approximately 0.31. The sign of the coefficient is positive and that contradicts economic theory. This means that an improvement in the regulatory environment would decrease the share of the alternative access infrastructure. However the coefficient is not significant even at a 10% level and therefore does not statistically differs from zero. This may be due to a relative stable regulatory environment in the relative countries of the EU for the years of this study.

- The coefficient of the variable GDP is approximately 0.00006 and is not statistically significant even at a 10% level of significance. This may be due to the high and relatively stable level of GDP of the EU countries investigated in this study.
- The coefficient of the variable HHI_intra is approximately 0.35. However the coefficient is not statistically significant even at a 10% level of significance and statistically does not differ from zero. This may be because the positive effect that has in the overall lines of the different access technologies may cancel out each other.

Appendix

Variable	Obs	Mean	Std. Dev.	Min	Max
log_share_~s	180	-1.512199	.9114914	-4.135167	-.0377019
log_price_~U	180	4.771604	.1773061	4.333362	5.269918
log_ratio	147	.2194674	.5773259	-1.083345	2.219203
lluyears	180	6.4	2.767731	1	13
RRI	132	1.263636	.4741038	.5	2.3
GDP	165	28603.03	6054.18	14400	39900
lagHHI_inter	132	.6425247	.1532506	.500002	.968512

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