Economics Bulletin

Volume 35, Issue 2

What Determines Technology Diffusion Across Frontiers? R&D Content, Human Capital and Institutions

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Citation: Andreas Assiotis and Marios Zachariades and Andreas Savvides, (2015) "What Determines Technology Diffusion Across Frontiers? R&D Content, Human Capital and Institutions", *Economics Bulletin*, Volume 35, Issue 2, pages 856-870
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Submitted: February 17, 2015. **Published:** April 03, 2015.

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1 Introduction

International technology diffusion has long been studied within both academic and policy-making circles. The literature addresses several questions. First, what forms does the diffusion of technology across international frontiers take? Second, to what extent does international technology diffusion contribute to the growth of output and total factor productivity (TFP) of the recipient economies? Third, what factors determine the diffusion of technology across countries?

The first two questions have been studied by, *inter alia*, Coe *et al.* (1997, 2009), Savvides and Zachariadis (2005), Papageorgiou *et al.* (2007). These papers concentrate on international technology diffusion in the form of both embodied (imports of capital goods) and disembodied (foreign stocks of R&D) technology. They demonstrate that both the embodied and disembodied channels contribute to increases in the level of TFP (Coe *et al.*), increases in TFP growth (Savvides and Zachariadis) and improvements in life expectancy (Papageorgiou *et al.*).

The third question on the determinants of technology diffusion, which is the subject of this paper, has received relatively little attention.[1] Caselli and Coleman (2001) and Caselli and Wilson (2004) investigate the embodied channel of technology diffusion through the import of capital goods. Caselli and Wilson distinguish between various types of capital goods imports and argue that, just like a distinction is made between different forms of labor (raw labor vs human capital or skilled vs unskilled), a distinction between different forms of physical capital must be made. For most countries, different types of capital goods imports are a suitable proxy for investment in different types of capital goods. Caselli and Wilson (2004) investigate the factors that determine the diffusion of different forms of capital goods while Caselli and Coleman (2001) the factors that determine the diffusion of computers across frontiers.

[1] Comin and Mestieri (2013) provide a recent summary of this literature.

International Technology Diffusion

The goal of our paper is to investigate the determinants of embodied international technology diffusion. The paper makes a number of contributions. First, we distinguish between different capital import categories but pay close attention to distinguishing between categories that encompass high- and low-R&D content. Second, we look at a wide number of factors that determine cross-country technology diffusion. Third, we focus on the impact of economic and political institutions on technology diffusion across a wide sample of countries and time, and, therefore, allow sufficient cross-country and time-series variation in institutional quality. Our paper combines the focus of Coe *et al.* (2009) on international technology spillovers and institutions with the methodological innovation in Caselli and Coleman (2001) and Caselli and Wilson (2004) on cross-country technology diffusion via the embodied channel of capital imports. Our findings contribute to understanding the mechanism via which institutions matter for cross-country economic outcomes, and are consistent with the framework proposed by Acemoglu and Robinson (2000). Fourth, we employ data from as wide a sample of countries and across time (from 1961 to 2011 for 127 countries), and thus avoid the narrow choice of countries/time periods found in previous studies. Fifth, we employ various estimation techniques and demonstrate the robustness of our results. Previous studies have been limited by the appropriateness of estimation methods.

We find that, among the variables we consider, economic and political institutions have a large and statitstically significant impact on capital imports. Moreover, this impact is evident and robust for capital imports such as computers that embody a high technology content but not for less technologically-intensive types of capital goods, such as metalworking machinery. Together, these results highlight the role of institutions in facilitating embodied technology diffusion rather than mere capital accumulation. Human capital exhibits a similar pattern to institutions in terms of the magnitude and significance of its impact on capital imports. Human capital has a greater impact on capital imports with high technology content and no significant impact for capital imports with low technology content, consistent with its role for facilitating the diffusion of technology as suggested by Nelson and Phelps (1966).[2] Our main findings are robust to accounting for fixed country effects, using lagged values of the explanatory variables and instruments to alleviate omitted variables and endogeneity issues.

2 Methodology and Data

The papers by Coe *et al.* (2009), Caselli and Coleman (2001), and Caselli and Wilson (2004) take a preliminary look at the relation between technology diffusion and institutions utilizing data for 24 countries during 1971-2004 in the first case, 1970-1990 for as many as 89 countries in the second case, and 1980-1997 for 40 countries in the third case. The definition and measure of institutions by these papers, however, differs significantly from the institutional quality measures typically used in the institutions-related literature. Caselli and Coleman(2001) and Caselli and Wilson (2004) omit fixed-country effects that may be important in capturing the idiosyncratic effects of omitted variables. Coe *et al.* (2009) account for fixed-country effects but consider a very limited sample of 24 OECD countries and a limited number (typically two or three) of control variables. In our paper, we use data from 1960 to 2010 for 127 countries and a number of institutional quality variables in a variety of specifications that include fixed country effects, time effects, time lags, and instrumental variables, along with a number of control variables, to alleviate omitted variables and endogeneity issues faced in the context of cross-country regressions.

Our study looks at the determinants of two different categories of capital goods imports. We distinguish between imports of computers and imports of metalworking machinery, two categories that embody widely differing R&D content: computers embody a large R&D content while metalworking machinery very little.[3] This distinction should provide insight into the role of different

[2] See Savvides and Stengos (2009) for a survey of the role of human capital in facilitating the diffusion of technology.

[3] Caselli and Wilson (2004) report that of nine industries considered, computers rank second in terms of R&D flow intensity while fabricated metal products ranks last.

determinants of the diffusion of goods that embody high and low R&D content, especially that of institutions and human capital.

Our econometric methodology uses panel estimation and includes in all specifications country fixed effects. All variables are measured as averages over 5 years for two reasons. First, to eliminate spikes that yearly data may produce and second to avoid (in a small number of cases) some yearly gaps that are present in the data. We examine the robustness of our results to possible endogeneity using lagged values of the explanatory variables and instruments for the effect of institutions.

The dependent variable is either imports of computers per worker or imports of metalworking machinery per worker. Data on imports come from the *International Trade by Commodity Statistics* database of the OECD. This database provides exports by OECD members according to SITC category. We measure the imports of each country as exports of the nine leading OECD capital-goods exporters to each country.[4] We consider a wide variety of explanatory variables: real income per worker, real investment per worker, manufacturing imports per worker, human capital as measured by the proportion of the workforce that has completed at least primary education, government expenditures share in GDP, share of agriculture in GDP, share of manufacturing in GDP, and aggregate imports per worker.[5] The time period ranges from 1961 to 2011 for a large panel of countries. While the majority of the variables are available for all the years, there are few missing variables for some years and countries.

This study pays special attention to the role of economic and political institutions. We denote institutions that influence the incentives for productive versus rent seeking activities as economic

[4] Computer imports is SITC category 752 in the OECD database and metalworking machinery imports is category 73. The nine leading exporters of capital goods are Belgium, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, U.K. and U.S.A.

[5] The sources of data for the explanatory variables are as follows: (1) real income per worker, real investment per worker, government expenditures share in GDP, and aggregate imports per worker are from the *Penn World Tables*; (2) manufacturing imports per worker are from the *International Trade by Commodity Statistics* of the OECD; (3) share of agriculture in GDP and share of manufacturing in GDP are from *National Accounts Main Aggregates* Database of the United Nations; and (4) proportion of the workforce that has completed at least primary education is from the *Barro-Lee Educational Attainment* dataset.

institutions. Additionally, we consider political institutions defined as constraints on government actors, including government officials. Such political constraints partially overlap with other types of constraints, especially in cases where laws or constitutional provisions prohibit the government from seizing property without just compensation. But they also include other constraints on government that have little to do with property, at least directly. We measure the quality of economic institutions by the variables Checks and Balances and Executive Constraints from the *Database of Political Institutions* and the *Polity IV* project, respectively. The quality of political institutions is measured by the degree of democratic government. We consider two distinct measure of democratic government, the Polity indicator from the *Polity IV* project and Democracy from *Freedom House*. All the institutional variables have been normalized between 0 and 1 with higher number denoting stronger institutions.

Finally, we also consider the legal origin of countries compiled by La Porta *et al.* (1998) as instrument for the role of institutions. According to the La Porta et al (1999) theory, these legal traditions spread throughout the world through conquest, colonization, and imitation, so differences in legal origin can be treated as relatively exogenous. There are five possible legal origins: English Common Law, French Civil Law, German Civil Law, Scandinavian Civil Code, and Socialist/Communist law. The legal origin dummies are constructed so that LEG_Xi = 1 if the legal system in country i is based upon X where X denotes British, French, German, Scandinavian or Socialist legal systems. We use all five dummies to instrument for the institutional variables. See La Porta et al. (1999) for more detailed descriptions as to how legal systems are classified and for their role in determining institutions.

Table 1: Explaining computer imports across countries with 5 year averages over the period 1961-2011: Fixed effects model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income per worker	0.063	0.012	0.009	0.048	-0.157	-0.208	-0.231	-0.192
	(0.217)	(0.221)	(0.220)	(0.222)	(0.289)	(0.290)	(0.287)	(0.286)
Investment per worker	0.215*	0.239**	0.226*	0.230*	0.273**	0.288**	0.276**	0.279**
	(0.117)	(0.121)	(0.121)	(0.124)	(0.114)	(0.117)	(0.115)	(0.117)
Manufacturing Imports	0.587***	0.576***	0.554***	0.571***	0.505***	0.493***	0.473***	0.492***
	(0.124)	(0.130)	(0.130)	(0.128)	(0.098)	(0.102)	(0.096)	(0.101)
Human Capital	0.218**	0.241**	0.257**	0.242**	0.191*	0.222**	0.225**	0.217*
	(0.103)	(0.109)	(0.105)	(0.110)	(0.109)	(0.112)	(0.110)	(0.113)
Checks and Balances	0.795***				0.729***			
	(0.178)				(0.178)			
Executive Constraints		0.568**				0.439**		
		(0.234)				(0.219)		
Democracy			0.968***				0.820***	
			(0.252)				(0.269)	
Polity				0.650**				0.514*
				(0.268)				(0.272)
Share of Agriculture					-0.017**	-0.017**	-0.019**	-0.018**
					(0.008)	(0.007)	(0.007)	(0.007)
Share of Manufacturing					0.012	0.014	0.016	0.014
					(0.012)	(0.013)	(0.012)	(0.013)
Imports per worker					0.124	0.128	0.121	0.131
					(0.094)	(0.100)	(0.102)	(0.101)
Government Purchases					-0.014	-0.015	-0.015	-0.015
					(0.011)	(0.011)	(0.011)	(0.011)
Constant	2.016	2.888	3.070	2.579	3.362	4.384*	4.606*	4.179*
	(1.954)	(2.002)	(1.965)	(2.063)	(2.554)	(2.511)	(2.456)	(2.486)
Observations	927	927	927	927	775	775	775	775
Number of Countries	127	127	127	127	121	121	121	121
R^2	0.772	0.766	0.771	0.767	0.789	0.781	0.786	0.782

Notes: *** p<0.01, ** p<0.05, * p<0.1 Heteroskedasticity-consistent finite sample standard errors in parentheses. We estimate a Fixed effects model of 5-year averages of computer impots per worker over 1960-2010 on 5-year averages of the log of real income per worker, the log of real Investment per worker, the log of manufacturing imports per worker from the OECD, primary education, goverment spending share in GDP, the share of agriculture in GDP, the share of manufacturing in GDP, and the log of total imports per worker. pw stands for per worker.

Table 2: Explaining computer imports across countries with 5 year averages over the period 1961-2011: Fixed effects model with economic and political institutions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income per worker	0.050	0.069	0.012	0.040	-0.165	-0.156	-0.229	-0.193
	(0.218)	(0.218)	(0.221)	(0.218)	(0.292)	(0.288)	(0.296)	(0.284)
Investment per worker	0.215*	0.216*	0.227*	0.232*	0.265**	0.273**	0.276**	0.280**
	(0.121)	(0.120)	(0.122)	(0.123)	(0.115)	(0.113)	(0.115)	(0.116)
Manufacturing Imports	0.569***	0.583***	0.555***	0.572***	0.494***	0.505***	0.474***	0.492***
	(0.129)	(0.125)	(0.131)	(0.128)	(0.096)	(0.098)	(0.093)	(0.101)
Human Capital	0.230**	0.219**	0.254**	0.241**	0.197*	0.191*	0.225**	0.218*
	(0.103)	(0.104)	(0.108)	(0.110)	(0.109)	(0.110)	(0.112)	(0.113)
Checks and Balances	0.520**	0.699***			0.537***	0.721***		
	(0.233)	(0.251)			(0.192)	(0.185)		
Executive Constraints			0.101	0.173			0.016	0.114
			(0.351)	(0.498)			(0.314)	(0.483)
Democracy	0.563*		0.877**		0.420		0.806**	
	(0.324)		(0.385)		(0.301)		(0.381)	
Polity		0.153		0.477		0.014		0.399
		(0.364)		(0.566)		(0.315)		(0.599)
Share of Agriculture					-0.018**	-0.017**	-0.019**	-0.018**
					(0.008)	(0.008)	(0.007)	(0.007)
Share of Manufacturing					0.014	0.012	0.016	0.014
					(0.012)	(0.013)	(0.012)	(0.013)
Imports per worker					0.122	0.124	0.121	0.130
					(0.098)	(0.094)	(0.102)	(0.101)
Government Purchases					-0.015	-0.014	-0.015	-0.015
					(0.011)	(0.011)	(0.011)	(0.011)
Constant	2.253	1.965	2.992	2.634	3.508	3.353	4.583*	4.190*
	(1.952)	(1.988)	(2.022)	(2.050)	(2.570)	(2.577)	(2.619)	(2.473)
Observations	927	927	927	927	775	775	775	775
Number of Countries	127	127	127	127	121	121	121	121
R^2	0.774	0.772	0.771	0.767	0.790	0.789	0.786	0.781

Notes: *** p<0.01, ** p<0.05, * p<0.1 Heteroskedasticity-consistent finite sample standard errors in parentheses. We estimate a Fixed effects model of 5-year averages of computer impots per worker over 1960-2010 on the first lag of 5-year averages of the log of real income per worker, the log of real Investment per worker, the log of manufacturing imports per worker from the OECD, primary education, goverment spending share in GDP, the share of agriculture in GDP, the share of manufacturing in GDP, and the log of total imports per worker. pw stands for per worker

Table 3: Explaining metalworking machinery imports across countries over the period 1961-2011: Fixed effects model.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income per worker	0.309	0.313	0.309	0.297	0.511**	0.510**	0.509**	0.499**
	(0.231)	(0.232)	(0.230)	(0.232)	(0.230)	(0.230)	(0.229)	(0.231)
Investment per worker	0.208*	0.207*	0.209*	0.210*	0.157	0.157	0.157	0.162
	(0.123)	(0.124)	(0.124)	(0.123)	(0.107)	(0.108)	(0.108)	(0.108)
Manufacturing Imports	0.708***	0.708***	0.713***	0.711***	0.694***	0.694***	0.693***	0.693***
	(0.052)	(0.052)	(0.051)	(0.052)	(0.062)	(0.061)	(0.061)	(0.062)
Human Capital	-0.079	-0.081	-0.080	-0.076	-0.102	-0.101	-0.101	-0.099
	(0.069)	(0.069)	(0.068)	(0.068)	(0.063)	(0.064)	(0.064)	(0.063)
Checks and Balances	-0.048				0.021			
	(0.124)				(0.150)			
Executive Constraints		-0.021				0.013		
		(0.113)				(0.133)		
Democracy			-0.156				0.016	
			(0.188)				(0.223)	
Polity				-0.151				-0.049
				(0.138)				(0.170)
Share of Agriculture					0.012**	0.012**	0.012**	0.012**
					(0.006)	(0.006)	(0.006)	(0.006)
Manufacturing Share					0.020**	0.020**	0.020**	0.020**
					(0.010)	(0.010)	(0.010)	(0.010)
Imports per worker					0.067	0.067	0.067	0.066
					(0.059)	(0.059)	(0.059)	(0.059)
Government Purchases					0.002	0.002	0.002	0.002
					(0.005)	(0.005)	(0.005)	(0.005)
Constant	-6.868***	-6.939***	-6.870***	-6.715***	-9.817***	-9.788***	-9.773***	-9.642***
	(1.758)	(1.775)	(1.756)	(1.778)	(1.964)	(1.933)	(1.910)	(1.941)
Observations	923	923	923	923	770	770	770	770
Number of Countries	126	126	126	126	120	120	120	120
R^2	0.534	0.534	0.535	0.535	0.524	0.523	0.523	0.524

3 Estimation and empirical results

Table 1 considers the determinants of imports of computers. The basic specifications in columns (1) to (4) each includes one of four indicators of economic or political institutional development separately along with a number of variables identified by previous work as significant determinants of embodied technological diffusion. The specifications in columns (5) to (8) include additional control variables (such as the share of agriculture and manufacturing in GDP, government purchases as a share in GDP, and aggregate imports per worker) as a check on the robustness of the results.

Investment per worker and manufacturing imports per worker exert a positive and significant effect on computer imports. On the other hand the level of per capita income does not appear to be significant. An important conclusion concerns the role of human capital: human capital facilitates the importation of computers, commodities that embody substantial R&D content. Economic and political institutions are also robust and important explanatory variables in columns (1) to (8) of Table 1. In particular, Checks and Balances in columns (1) and (5) and Democracy in columns (3) and (7) have a very large and significant effect on computer imports irrespective of the addition of extra control variables. Executive Constraints and Polity also have a strong relation with computer imports.

To investigate the robustness of our results and to assess the individual importance of different types of institutions, in Table 2 we consider economic (Checks and Balances or Executive Constraints) and political (Democracy or Polity) institutions together in the same specification. Economic institutions as measured by Checks and Balances have a distinct, robust and significant impact on computer imports, even when political institutions are included in the same specification. Political institutions in the form of Democracy retain their significant impact for the most part but become weaker when we include additional controls.

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In Table 3, we consider imports of metalworking machinery, a capital goods import category that embodies low levels of R&D. In effect, this helps us distinguish between the potential role of institutions in facilitating embodied technology diffusion versus their potential role as mere capital accumulation. We find that institutions play no significant role in explaining low R&D content imports in the form of metalworking machinery. This is in sharp contrast to their important and robust positive role for high R&D capital imports in the form of computers, suggesting that institutions facilitate technology diffusion rather than mere capital accumulation.

The findings on the importance of institutions in facilitating technology diffusion is mirrored by that for human capital. Several theories (see, for example, Savvides and Stengos (2009, ch. 4) for a survey) emphasize the role of human capital in facilitating the diffusion of technology. We would expect human capital to influence significantly the diffusion of imports embodying high R&D content while not to matter for low R&D content imports. This is verified by our results: human capital has a positive and significant effect for imports of computers but is insignificant as a determinant of imports of metalworking machinery.

We conducted various robustness checks of our results to different specifications and estimation methods. To allow for possible endogeneity between the explanatory variables and computer imports we use lagged values of the explanatory variables. This allows us to check that the relation between institutions and computer imports is not merely contemporaneous partial correlation.

As an additional robustness check we utilize instrumental variables estimation to allow for endogeneity of institutions. More specifically, we use legal origin variables as instruments, variables that have been widely used in the institutions-related literature. Our findings regarding the impact of institutions and human capital on high R&D capital imports in the form of computer imports are quite robust. Once again, economic and political institutions and human capital are shown to matter for this form of embodied technology diffusion as shown in Tables 4 and 5. At the same

Table 4: Explaining computer imports across countries with 5 year averages over the period 1961-2011: Fixed effects model, IV estimation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income per worker	0.057	0.020	0.015	0.061	0.066	-0.26	-0.06	-0.184
	(0.20)	(0.20)	(0.19)	(0.20)	(0.216)	(0.215)	(0.21)	(0.214)
Investment per worker	0.178*	0.185**	0.192*	0.193*	0.222**	0.226**	0.236**	0.225**
	(0.09)	(0.08)	(0.11)	(0.11)	(0.10)	(0.10)	(0.10)	(0.106)
Manufacturing Imports	0.70***	0.683***	0.67***	0.678***	0.520***	0.489***	0.477***	0.492***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Human Capital	0.183**	0.19**	0.23***	0.206**	0.11*	0.14**	0.17**	0.145**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.06)	(0.07)	(0.8)	(0.07)
Checks and Balances	0.90***				0.845***			
	(0.26)				(0.25)			
Executive Constraints		0.691**				0.610**		
		(0.203)				(0.186)		
Democracy			0.87***				0.75***	
			(0.25)				(0.229)	
Polity				0.70***				0.609***
				(0.20)				(0.185)
Share of Agriculture					-0.018***	-0.021***	-0.022**	-0.023***
					(0.006)	(0.006)	(0.007)	(0.006)
Share of Manufacturing					0.013	0.014	0.015	0.014
					(0.012)	(0.011)	(0.012)	(0.012)
Imports per worker					0.165***	0.154***	0.137**	0.15***
					(0.05)	(0.05)	(0.06)	(0.05)
Government Purchases					-0.017***	-0.019***	-0.018***	-0.019***
					(0.006)	(0.006)	(0.007)	(0.006)
Observations	927	927	927	927	775	775	775	775
Number of Countries	127	127	127	127	121	121	121	121
R^2	0.78	0.79	0.79	0.78	0.82	0.83	0.83	0.82
Sargan Test, p<	0.22	0.24	0.27	0.19	0.27	0.25	0.23	0.18

Notes: *** p<0.01, ** p<0.05, * p<0.1 Heteroskedasticity-consistent finite sample standard errors in parentheses. We estimate a Fixed effects model of 5-year averages of computer impots per worker over 1960-2010 on 5-year averages of the log of real income per worker, the log of real Investment per worker, the log of manufacturing imports per worker from the OECD, primary education, goverment spending share in GDP, the share of agriculture in GDP, the share of manufacturing in GDP, and the log of total imports per worker. pw stands for per worker.

Table 5: Explaining computer imports across countries with 5 year averages over the period 1961-2011: Fixed effects model with economic and political institutions. IV estimation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income per worker	0.060	0.081	0.011	0.063	-0.154	-0.182	-0.192	-0.181
	(0.218)	(0.18)	(0.17)	(0.217)	(0.289)	(0.268)	(0.28)	(0.263)
Investment per worker	0.235**	0.27*	0.23*	0.215*	0.226**	0.239**	0.249**	0.227**
	(0.10)	(0.141)	(0.12)	(0.117)	(0.121)	(0.121)	(0.12)	(0.11)
Manufacturing Imports	0.557***	0.53***	0.534***	0.56***	0.513***	0.554***	0.492***	0.555***
	(0.13)	(0.14)	(0.16)	(0.15)	(0.12)	(0.130)	(0.101)	(0.131)
Human Capital	0.19**	0.14***	0.12**	0.13**	0.15*	0.16**	0.187**	0.16*
	(0.09)	(0.05)	(0.06)	(0.06)	(0.07)	(0.07)	(0.09)	(0.08)
Checks and Balances	0.58**	0.721***			0.581***	0.743***		
	(0.26)	(0.27)			(0.22)	(0.21)		
Executive Constraints			0.14	0.207			0.014	0.143
			(0.31)	(0.44)			(0.473)	(0.461)
Democracy	0.61**		0.84**		0.44		0.84**	
	(0.31)		(0.39)		(0.29)		(0.41)	
Polity		0.14		0.491		0.016		0.416
		(0.28)		(0.58)		(0.37)		(0.566)
Share of Agriculture					-0.017**	-0.017**	-0.018**	-0.019**
					(0.008)	(0.008)	(0.007)	(0.007)
Share of Manufacturing					0.013	0.013	0.014	0.012
					(0.012)	(0.012)	(0.013)	(0.013)
Imports per worker					0.14	0.13	0.13	0.124
					(0.08)	(0.09)	(0.10)	(0.09)
Government Purchases					-0.014	-0.015	-0.015	-0.014
					(0.04)	(0.03)	(0.01)	(0.011)
Observations	927	927	927	927	775	775	775	775
Number of Countries	127	127	127	127	121	121	121	121
R^2	0.87	0.83	0.82	0.78	0.76	0.77	0.76	0.781
Sargan Test, p<	0.26	0.21	0.25	0.17	0.24	0.23	0.24	0.18

Notes: *** p<0.01, ** p<0.05, * p<0.1 Heteroskedasticity-consistent finite sample standard errors in parentheses. We estimate a Fixed effects model of 5-year averages of computer impots per worker over 1960-2010 on the first lag of 5-year averages of the log of real income per worker, the log of real Investment per worker, the log of manufacturing imports per worker from the OECD, primary education, goverment spending share in GDP, the share of agriculture in GDP, the share of manufacturing in GDP, and the log of total imports per worker. pw stands for per worker

Table 6: Explaining metalworking machinery imports across countries over the period 1961-2011: Fixed effects model, IV estimation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income per worker	0.291	0.27	0.31	0.30	0.510*	0.501**	0.497**	0.512**
	(0.211)	(0.223)	(0.218)	(0.23)	(0.23)	(0.229)	(0.23)	(0.22)
Investment per worker	0.239**	0.235**	0.227*	0.23*	0.113	0.161	0.18	0.161
	(0.095)	(0.095)	(0.096)	(0.094)	(0.097)	(0.10)	(0.108)	(0.11)
Manufacturing Imports	0.758***	0.77***	0.78***	0.774***	0.775***	0.794***	0.803***	0.793***
	(0.041)	(0.041)	(0.042)	(0.041)	(0.049)	(0.048)	(0.049)	(0.048)
Human Capital	-0.072	-0.079	-0.080	-0.087	-0.091	-0.11	-0.12	-0.11
	(0.071)	(0.070)	(0.069)	(0.070)	(0.073)	(0.07)	(0.07)	(0.07)
Checks and Balances	-0.063				0.024			
	(0.22)				(0.162)			
Executive Constraints		-0.041				0.017		
		(0.163)				(0.16)		
Democracy			-0.161				0.018	
			(0.162)				(0.232)	
Polity				-0.182				-0.046
				(0.151)				(0.165)
Share of Agriculture					0.03**	0.04**	0.04**	0.06**
					(0.005)	(0.005)	(0.005)	(0.005)
Share of Manufacturing					0.018**	0.017**	0.016**	0.017**
					(0.007)	(0.007)	(0.007)	(0.007)
Imports per worker					0.015	0.021	0.031	0.024
					(0.053)	(0.05)	(0.05)	(0.05)
Government Purchases					0.005	0.005	0.005	0.006
					(0.005)	(0.005)	(0.005)	(0.005)
Observations	923	923	923	923	770	770	770	770
Number of Countries	126	126	126	126	120	120	120	120
R^2	0.52	0.53	0.54	0.54	0.53	0.54	0.54	0.54
Sargan Test, p<	0.11	0.14	0.15	0.14	0.12	0.15	0.15	0.13

time, the results for metalworking machinery remain unchanged as shown in Table 6.

4 Conclusion

This paper investigates the determinants of two categories of imports of capital goods - computer equipment and metalworking machinery - that constitute an important avenue for technology diffusion across countries. The two categories are distinct as far as their R&D content, with the former embodying a much larger content. We show that political and economic institutions as well as education are important determinants of the diffusion of computers but not for metalworking machinery. This results highlights the role played by institutions and education in the diffusion of high-R&D content imports while it is insignificant for low R&D embodying imports. The former imports go beyond mere capital accumulation and embody R&D transfer.

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