INTANGIBLE CAPITAL AND GROWTH: AN APPLICATION OF TURKEY

by

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INTANGIBLE CAPITAL AND GROWTH: AN APPLICATION OF TURKEY

Sina Çolak

The purposes of this thesis are to measure intangible investment and to examine its contribution to economic growth in Turkey. Following the approach of Corrado, Hulten, and Sichel (2006), business investment in intangible assets is estimated as 2.95% of GDP in 2003 and increased to 4.18% in 2012. Although these rates are significantly lower than rates for the United States, Canada and the United Kingdom, they are comparable to estimates for Italy, Spain and Brazil. On the other hand, investment in innovative properties is found notably lower in Turkey compared to other countries, whereas contribution of intangible capital deepening to labor productivity growth follows a similar rate with those of European countries. Promoting innovative activity through intangible investment is crucial for solutions of major problems in Turkish economy. However, I claim complex market regulations, scarce financing options, low level of property rights protection, and insufficient high skilled labor force are discouraging Turkish companies from investing in intangible assets by presenting cross-country comparisons and evidences from a survey.

Keywords: Economic Growth, Investment, Intangible Assets, Knowledge-Based Capital, Productivity, Innovation.

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MADDİ OLMAYAN SERMAYE VE BÜYÜME: TÜRKİYE UYGULAMASI

Sina Çolak

Bu tezin amacı Türkiye'de maddi olmayan varlıklara yapılan yatırımları hesaplamak ve bu yatırımların ekonomik büyümeye etkisini sorgulamaktır. Corrado, Hulten ve Sichel'in (2006) yöntemini uygulayarak özel sektörün maddi olmayan varlıklara yaptığı yatırımların 2003 yılında GSYİH'nın %2,95'i olduğu ve 2012'de %4,18'e yükseldiği hesaplanmıştır. Bu oranlar Amerika Birleşik Devletleri, Kanada ve Birleşik Krallığa kıyasla düşük olsa da İtalya, İspanya ve Brezilya için hesaplanan oranlara yakındır. Türkiye'de diğer ülkelere kıyasla yenilikçi varlıklara yapılan yatırımların düşük kaldığı ama maddi olmayan sermaye birikimindeki artışın işgücü verimliliğine Avrupa ülkelerindekine benzer seviyelerde katkıda bulunduğu tespit edilmiştir. Maddi olmayan varlıklara yatırım yoluyla yenilikçi faaliyetleri arttırmak Türk ekonomisinin en önemli problemlerine çözüm olabilir. Buna rağmen, ülkeler arası karşılaştırmalardan ve bir anketten faydalanarak Türkiye'deki karmaşık piyasa düzenlemelerinin, yetersiz finansman koşullarının, mülkiyet haklarının zayıf biçimde korunmasının ve kalifiye iş gücü yetersizliğinin Türk şirketlerini maddi olmayan varlıklara yatırım yapmaktan uzaklaştırdığı savında bulunuyorum.

Anahtar Sözcükler: Ekonomik Büyüme, Yatırım, Maddi Olmayan Varlıklar, Bilgiye Dayalı Sermaye, Verimlilik, Yenilik.

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Abstract

The purposes of this thesis are to measure intangible investment and to examine its contribution to economic growth in Turkey. Following the approach of Corrado, Hulten, and Sichel (2006), business investment in intangible assets is estimated as 2.95% of GDP in 2003 and increased to 4.18% in 2012. Although these rates are significantly lower than rates for the United States, Canada and the United Kingdom, they are comparable to estimates for Italy, Spain and Brazil. On the other hand, investment in innovative properties is found notably lower in Turkey compared to other countries, whereas contribution of intangible capital deepening to labor productivity growth follows a similar rate with those of European countries. Promoting innovative activity through intangible investment is crucial for solutions of major problems in Turkish economy. However, I claim complex market regulations, scarce financing options, low level of property rights protection, and insufficient high skilled labor force are discouraging Turkish companies from investing in intangible assets by presenting cross-country comparisons and evidences from a survey.

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Özet

Bu tezin amacı Türkiye'de maddi olmayan varlıklara yapılan yatırımları hesaplamak ve bu yatırımların ekonomik büyümeye etkisini sorgulamaktır. Corrado, Hulten ve Sichel'in (2006) yöntemini uygulayarak özel sektörün maddi olmayan varlıklara yaptığı yatırımların 2003 yılında GSYİH'nın %2,95'i olduğu ve 2012'de %4,18'e yükseldiği hesaplanmıştır. Bu oranlar Amerika Birleşik Devletleri, Kanada ve Birleşik Krallığa kıyasla düşük olsa da İtalya, İspanya ve Brezilya için hesaplanan oranlara yakındır. Türkiye'de diğer ülkelere kıyasla yenilikçi varlıklara yapılan yatırımların düşük kaldığı ama maddi olmayan sermaye birikimindeki artışın iş gücü verimliliğine Avrupa ülkelerindekine benzer seviyelerde katkıda bulunduğu tespit edilmiştir. Maddi olmayan varlıklara yatırım yoluyla yenilikçi faaliyetleri arttırmak Türk ekonomisinin en önemli problemlerine çözüm olabilir. Buna rağmen, ülkeler arası karşılaştırmalardan ve bir anketten faydalanarak Türkiye'deki karmaşık piyasa düzenlemelerinin, yetersiz finansman koşullarının, mülkiyet haklarının zayıf biçimde korunmasının ve kalifiye iş gücü yetersizliğinin Türk şirketlerini maddi olmayan varlıklara yatırım yapmaktan uzaklaştırdığı savında bulunuyorum.

Anahtar Kelimeler: Ekonomik Büyüme, Yatırım, Maddi Olmayan Varlıklar, Bilgiye Dayalı Sermaye, Verimlilik, Yenilik

Contents

List of Tables

List of Figures

1 Introduction and Background

In the early 2000s, some researchers recognised the importance of intangible capital in generating innovation and promoting economic growth. Initial studies mainly focused on characterizing intangible capitals and measuring investment in intangible assets since they are essential in managing intangibles as a source of growth at macroeconomic level as stated by U.S. Federal Reserve Chairman Ben S. Bernanke in May 2011: "We will be more likely to promote innovative activity if we are able to measure it more effectively and document its role in economic growth".

Nakamura (2001) defines intangible investment as "private expenditures on assets that are intangible and necessary to the creation and sale of new or improved products and processes". In addition to examining possible impacts of capitalizing intangibles on the U.S. national accounts, he estimates investment in intangibles as at least 1 trillion dollars annually. Prescott and McGrattan (2005) argues that the basic neoclassical growth model accounts poorly for the behavior of the US economy after 1980s, as a result of unmeasured intangible capital investments. They define intangible capitals as those that can't be touched -or easily defined- including patents, trademarks, business know-how, reputation, and investments in building organizations.

In their seminal work, Corrado, Hulten, and Sichel (hereafter CHS, 2006) extend Nakamura's definition for intangible investment, and show the implications of capitalizing intangibles for growth accounting. They characterize intangible capitals in three broad categories: computerized information innovative property and economic competencies. Computerized information includes computer software and computerized databases. Innovative property embodies R&D activity of business enterprises and scientists; new product/service design; entertainment and artistic originals; and mineral exploration. Economic competencies contain expenditures for advertising and marketing; development of firm-specific human capital; and organizational formation, change and development.

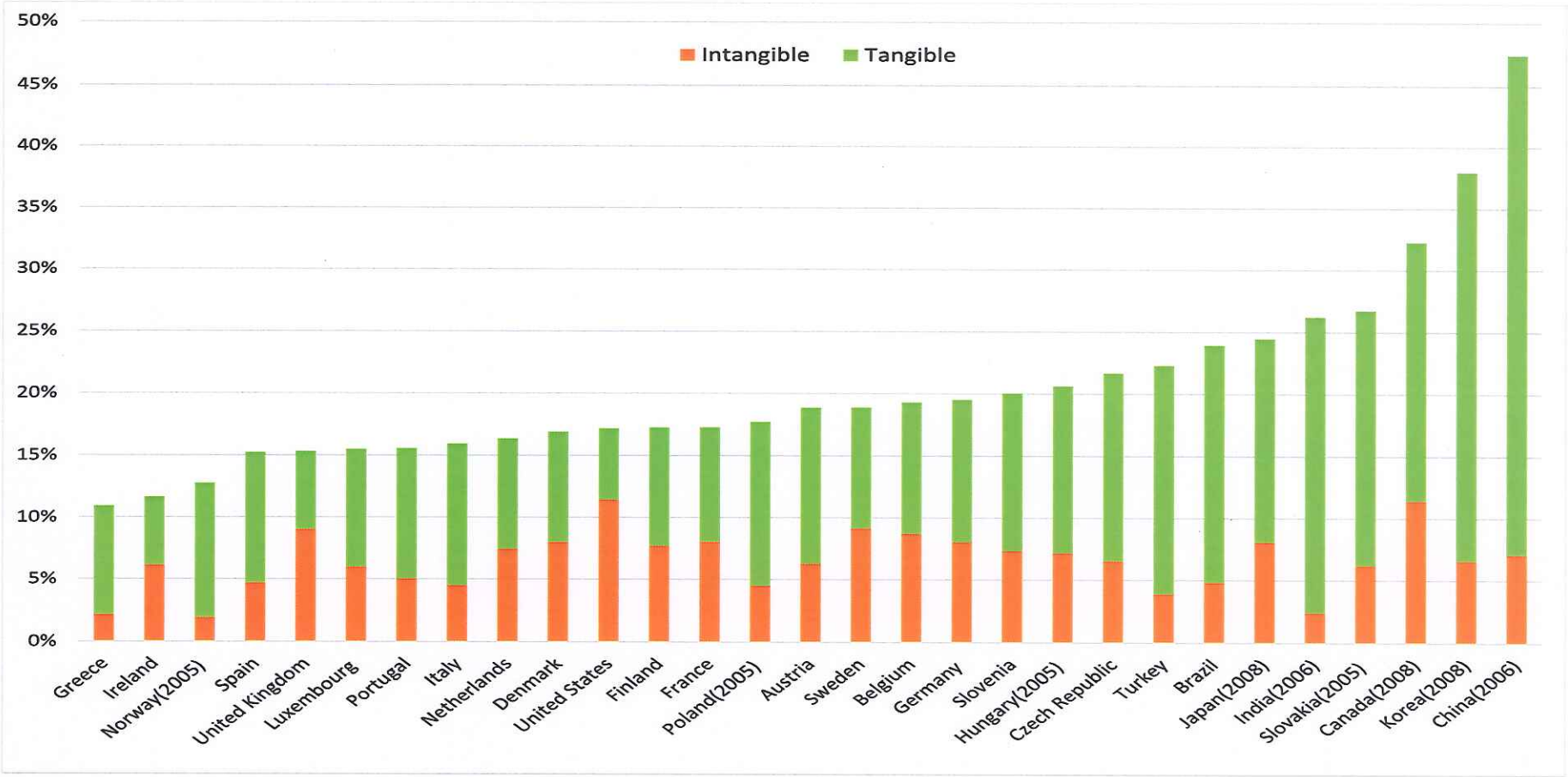
Traditional measures of capital investments in national accounts consist primarily of tangible assets such as property, plant and equipment. On the other hand, most of the intangible assets considered as consumed intermediate goods and therefore does not appear

separately in GDP accounts. CHS claim that the determination of what expenditures are current consumption and what are capital investment should be governed by consumer utility maximization. Capital investments are those that subtract from current period consumption to increase consumption in the future. Thus, from the perspective of the consumer, there is no basis for treating intangible capital differently from tangible capital. They argue that the national economic accounts should be extended to include all the forms of intangible capital that fit this definition. CHS add intangible capital to the standard sources-of-growth (SOG) framework and found that the inclusion of intangible capital makes a significant difference in the observed patterns of U.S. economic growth. The rate of change of output per worker increases more rapidly, capital deepening becomes the unambiguously dominant source of growth in labor productivity and the role of multifactor productivity is correspondingly diminished.

Some studies adopted the methodology of CHS (2006) to approximate intangible capital investments in other countries. These include Fukao and Hamagata (2007), and Miyagawa and Hisa (2013) for Japan; Haskel et al. (2007) for the United Kingdom; Van Rooijen-Horsten et al. (2008) for the Netherlands; Belhoucine (2009) and Baldwin et al. (2012) for Canada; Barnes and McClure (2009) for Australia; Jalava (2007) for Finland; Delbecque and Nayman (2010) for France; Delbecque and Bounfour (2011) for Germany; Hulten and Hao (2011) for China; Chun and Rhee (2011) for Korea; Hulten et al. (2012) for India; and Dutz et al. (2012) for Brazil. In addition to these studies, three large projects, funded by European Commission, had been conducted to measure intangible investment in European countries: INNODRIVE, COINVEST and INTAN-INVEST

Intangible capital investment for some countries is represented in Figure 1 with a comparison of tangible capital investment. Figure 1 indicates that investment in intangible capital exceeded 10% of GDP in some countries. Moreover, investment in intangibles outpaced tangible capital investment in U.S. and some European countries, where these countries arguably have their greatest comparative advantage in knowledge creation.

Figure 1: Business Investment in Intangible and Tangible Assets as % of GDP (2010)



Source: Based on INTAN-INVEST (www.intan-invest.net), with additional information from: Eurostat, US BEA and national statistics offices for tangible investment and GDP; the Japanese Industrial Productivity database; Chun et al. (2012) for intangible investment in Korea; Baldwin et al. (2012) for intangible investment in Canada; Hulten and Hao (2011) for intangible investment in China; Hulten et al. (2012) for intangible investment in India; Dutz et al. (2012) for intangible investment in Brazil. Data for Turkey is estimated by the author.

The purpose of this study is to explain the role of intangibles in Turkish economy. In the following section, I show intangible capitals' current treatment in national accounts, estimate intangible investment in Turkey, and detail my methodology and findings. In section 3, I investigate effects of intangible capital deepening in Turkish economic growth. I list my assumptions, explain the growth model and compare my findings with other countries. In section 4, I describe the importance of intangibles for Turkey. In order to suggest policy actions, I list the possible drivers of intangibles investment growth. Finally, I state a survey about Turkish firms' experiences with intangibles that is line with my previous findings.

2 Intangible Capital Investments in Turkey

Identifying all relevant intangible asset types is a big challenge. In this study, I follow the CHS (2005) classification since it is the mainstream framework in the related literature. In addition, adopting CHS methodology allows deriving data that is well comparable with findings of studies for other countries. Even though CHS classification is commonly adopted in the literature, sometimes the status of R&D or other new CHS assets has been questioned. A detailed discussion on this regard is available on the methodological notes of INTAN-INVEST Project.

With regard to intangibles, The System of National Accounts (SNA) 1993 recommends costs of producing artistic originals and computer software, and expenses of mineral exploration to be treated as fixed investments. The SNA 2008 recommends that, when intellectual property products can provide some form of monopoly benefits, they should be treated as an asset. These intellectual property products are defined as "the result of research, development, investigation or innovation leading to knowledge that the developers can market or use to their own benefit in production because use of the knowledge is restricted by means of legal or other protection". R&D expenditures are explicitly treated as assets, even though these expenditures may not always be covered by intellectual property protection. In the SNA 2008, human capital is explicitly excluded because of the difficulty in identifying ownership, and marketing expenditures are excluded because of

the difficulty in measuring their value. According to SNA 2008, the following intangibles are gross fixed capital formation: computer software and databases; mineral exploration; entertainment, literary, and artistic originals; R&D expenditures; and other intellectual property products (unspecified).

Table 1 shows the CHS's list of intangibles and whether or not each intangible asset is included in Turkish, US and EU countries' national accounts. Turkish Statistical Institute (TURKSTAT) reported that they do not have any account for artistic originals and mineral exploration but they include computer software investment of government in national accounts. However, TURKSTAT also announced that they started to running surveys to create new supply-use tables and they plan to add around 40 different intangible assets to national accounts after 2016.

Table 1: Intangible Capital Assets in National Accounts

Asset Type	**Included in National Accounts?**		
	Turkey	US	EU
Computerized Information			
1. Software	No[1]	Yes	Yes
2. Databases	No[1]	?[2]	?[2]
Innovative Property			
3. Mineral Exploration	No	Yes	Yes
4. R&D (Scientific)	No	Satellite	Satellite[3]
5. Entertainment and Artistic Originals	No	No	No
6. New Products/Systems in Financial Services	No	No	No
7. Design and Other New Products/Systems	No	No	No
Economic Competencies			
8. Brand Equity	No	No	No
a. Advertising	No	No	No
b. Market Research	No	No	No
9. Firm-Specific Resources	No	No	No
a. Employer-Provided Training	No	No	No
b. Organizational Structure	No	No	No

Source: INTAN-INVEST and TURKSTAT
[1]Only public sector's investment is included in Turkish National Accounts.
[2]SNA 1993 recommended capitalizing computerized databases.
[3]Only for some countries.

In this study, though CHS framework is embraced, data sources and estimating methods were adjusted according to availability. Methodologies of European projects are

adopted since most of the available data sources are similar for European countries and Turkey, as a result of Turkey's accession process to European Union and close partnership between TURKSTAT and EUROSTAT. However, there are several restrictions when estimating intangible investment in Turkey. First of all, some of the data sources used in these projects is not available for Turkey. In these cases, experimental estimating methods or other researches' methodologies were pursued according to data availability. Another restriction is time range of the available data. Most of the surveys and statistical reports are only available for years after 2001. Thus, intangible investment series is estimated from 2003 to 2012. Unless otherwise stated, source of the data is TURKSTAT.

2.1 Computerized Information

TURKSTAT reported that computer software investments of business sector is not capitalized within their gross fixed capital formation (GFCF) data, thus, there is not an available official estimate. In contrast to the European projects which mostly used EU KLEMS database, my software estimates are based on TURKSTAT's Annual Industry and Service Statistics. I estimate computerized information investment in Turkey as the sum of computer software and database industries' turnovers. Table 2 represents my estimations.

Table 2: Computerized Information Investments in Turkey

Year	Nominal Investment*	% of GDP
2003	0,968	0.21
2004	1,413	0.25
2005	1,812	0.28
2006	2,535	0.33
2007	2,876	0.34
2008	4,127	0.43
2009	4,644	0.49
2010	5,779	0.53
2011	6,767	0.52
2012	8,345	0.59

* Millions of TL.

2.2 Innovative Property

This category includes intangible assets that reflect both technological and creative innovations, and it is estimated as sum of five sub-categories: mineral exploration; research and development (R&D); entertainment, artistic, and literary originals (copyright costs); new products and systems in the financial services industry; and new architectural and engineering designs.

Mineral Exploration

According to SNA 1993, this category includes acquisition of the rights to explore, exploratory drilling and sampling, various topographic and geo-scientific studies, and evaluation of both technical feasibility and commercial viability. Though mineral exploration has been included as capital in the SNA since 1993, previous studies revealed that detailed survey data is available for only some major producers. TURKSTAT reported that there is no estimation available in this category for Turkey. According to Mineral Research & Exploration General Directorate of Turkey (MTA), mineral exploration investment in Turkey is very insignificant and heavily dominated by exploration cost of gold. When gold is excluded, MTA estimates average yearly mineral exploration investment in Turkey as 60 millions $. Data for exploration cost of gold is obtained from Turkish Gold Miners Association.

Research and Development (R&D)

OECD Frascati Manual defines R&D as the activity whose purpose is to increase the stock of knowledge, including knowledge of man, culture, and society that is used to devise new applications. R&D expenditures are treated as assets in SNA since 2008. When calculating R&D investments, expenditure of the computer sector and the financial intermediation sector are subtracted from business R&D expenditures in order to avoid double counting with software and new financial products. TURKSTAT conducts Research and Development Activities Survey since 2005 but R&D expenditure estimates of the computer sector and the financial intermediation sector are available only after 2010. When

Turkstat data is not available, I used STAN (ANBERD) database of OECD.

Entertainment, Artistic and Literary Originals

This category mainly consist of copyright cost in book publishing, motion picture production, sound recording production and broadcasting industries. Entertainment, artistic and literary originals are already treated as capital in national accounts of many countries. European projects use national account data for the most of the European countries. TURKSTAT publishes intangible and tangible investment estimates for broadcasting industry (TURKSTAT Radio and Television Institution Statistics), but official estimates are not available for other industries. For these industries, I assume that copyright cost account for 20% of good and service purchases in these industries. This methodology is also adopted by Fukao et al. (2007) for Japan and by Dutz et al. (2012) for Brazil. Good and service purchases data for each industry is available in TURKSTAT Annual Industry and Service Statistics.

New Product Development Costs in the Financial Services Industry

Financial services industries routinely research, develop, and introduce new products. According to CHS, costs of such activities are in fact non-scientific R&D expenditures but they are not captured by official surveys since these expenditures mostly do not lead to an identifiable asset, such as a copyright or license. In the literature, there are three popular methodologies to measure new product development costs in the financial services industry. I calculated new financial product cost for Turkey by following the each of these methodologies.

Nakamura (2001) proxies new product development costs in the financial services industries as a proportion (half) of the noninterest expenses of banks and non-depository institutions. I obtained non-interest expenses data from Banking Regulation and Supervision Agency of Turkey.

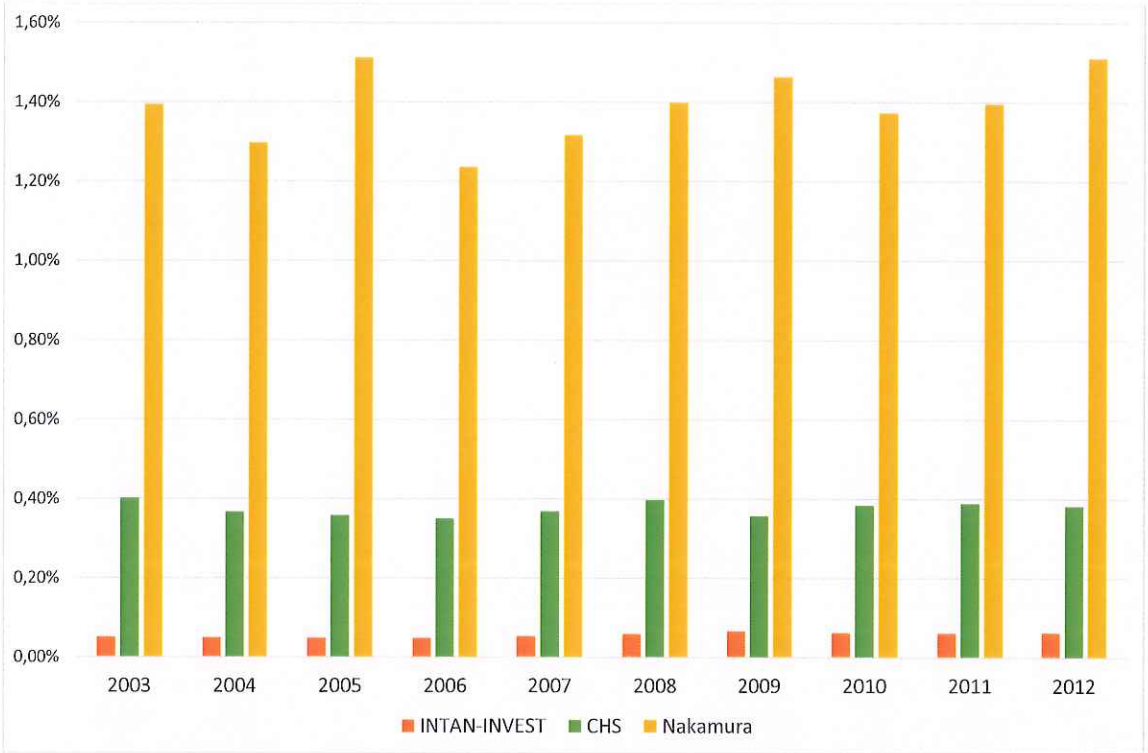
CHS (2005) broaden the coverage to include other financial institutions (security and commodity brokers and other financial investments and related activities), and for their

proxy they use 20 percent of all intermediate purchases by the industry. I use TURKSTAT'S Financial Intermediary Institutions Statistics for intermediate purchases data.

INTAN-INVEST Project assumes that most of financial costs of innovation in financial services industry consist in wages, based on the evidence reported in Hunt (2008). They find that 8% of compensation of high skilled in financial services industry is a good approximation for the innovation expenditure in the industry. In order to calculate compensations of high skilled workers in the industry, I multiply "labor compensation in financial services industry" with "the share of high-skilled in the industry's labor compensation". I took labor compensation data from TURKSTAT'S Financial Intermediary Institutions Statistics and share of high-skilled labor compensation data from the Socio Economic Accounts of World Input-Output Database (WIOD). Then I assume that 8% of this amount is new product development investment.

Figure 2 shows new financial product development costs estimates of three different methodologies. There are large differences between results of these methodologies. I adopted the CHS's methodology for this category since it is the most common used one.

Figure 2: New Financial Products Development Cost Estimates (as % of GDP)



New Architectural and Engineering Designs

According to Robbins (2010), some national accounts already include some of these expenditures as a part of residential investment or as a part of the installed value of equipment and structures, but this treatment only recognizes the role of the designs in the value of the tangible asset that is used repeatedly, rather than the separate role of the design in multiple uses. As a separate intangible asset, the capitalized component of designs reflects this separate quality. Following the common methodology, I estimated investment in this category as half of turnover of "architectural and engineering activities and related technical consultancy" industry. Turnover data is obtained from TURKSTAT Annual Industry and Service Statistics.

Results

Total investment in innovative property intangibles is represented in Table 3. It is notable that expenditures of mineral exploration and entertainment and artistic originals constitute only 8% of total innovative property investments. For 2003-2010, R&D and design investments are the essential sources of the growth in this category. R&D investments tripled and new design expenditures doubled in this period.

Table 3: Innovative Property Investments in Turkey

Year	Nominal Investment*	% of GDP
2003	3,247	0.71
2004	4,122	0.74
2005	4,856	0.75
2006	6,527	0.86
2007	8,176	0.97
2008	10,791	1.14
2009	9,120	0.96
2010	11,441	1.04
2011	14,018	1.08
2012	16,293	1.15

* Millions of TL.

2.3 Economic Competencies

CHS define the economic competencies category of intangibles as "the value of brand names and other knowledge embedded in firm-specific human and structural resources". It comprises expenditures on advertising, market research, firm-specific human capital and organizational structure.

Advertising

Because advertising is intended to create a perceived brand of the firm in the minds of potential consumers and the development of this brand has to be considered key in the yield of future benefits, advertising expenditure is accepted as an intangible investment rather than simple short- or medium-term cost. Landes and Rosenfield (1994) found that 60% of advertisements has a service life of at least one year and can be capitalized. Thus, CHS and other studies recorded 60% of advertising expenditure as investment.

There are three available data source for advertisement expenditures in Turkey. Zenith Optimedia publishes advertisement expenditures estimates but European projects mentioned methodological problems about this dataset. The data is available in reports of Turkish Association of Advertising Agencies yet it only cover association members. Thus, most reliable data is revenues of advertising industry that is available in TURKSTAT Annual Industry and Service Statistics. I assume %60 of industry revenues is intangible investment.

Market Research

Although the properties of markets tend to change consistently over time, CHS claims it is reasonable to assume that the knowledge of certain market segments and consumer attitudes holds benefits for more than one year. Thus, they recorded market research expenditures as business intangible investment. I used the turnover of market research firms as a proxy for the expenditure, and took the data from TURKSTAT Annual Industry and Service Statistics. However, turnover of market research firms constitutes only purchased component of market research. The cost of own-account market and consumer research

was assumed same as the purchased component.

Firm-Specific Human Capital

The one component of firm-specific human capital is the cost of providing training. For this component, I used "cost of vocational training courses" data from TURKSTAT's Continuing Vocational Training in Enterprises Survey. Data is available for only 2007 and 2010. I held the share constant for the year before 2007 and after 2010 and linearly interpolated values for the years between 2007 and 2010. In order to estimate the cost of employer provided training, I multiplied this ratio by the compensation of employees.

The other component is apprenticeships expenditure. The data is obtained from Labor Cost Survey of EUROSTAT. Data is available only for 2008. I assumed the ratio is constant for other years.

Organizational Structure

CHS define investments in organizational change and development as the sum of two components: the purchased component which is represented by management consultant fees and the own-account component which is represented by the value of executive time spent on improving the effectiveness of business organizations. Following the CHS, I calculated purchased component as %80 of revenues of management consultancy industry. For the own-account component, I adopted the methodology of INTAN-INVEST project. This component is estimated as %20 of gross earnings of managers. To estimate the gross earnings of managers, I first calculated share of managers' earnings in total labor compensation. I calculated the gross earnings of managers and gross earnings of all employees by multiplying the mean annual earnings by number of employees. Mean annual earnings is obtained from TURKSTAT's Structure of Earnings Survey and number of employees by occupation is from Labor Force Survey of EUROSTAT. Since mean annual earnings and number of employees by occupation data is available only for 2006 and 2010, I linearly interpolated share of managers' earnings in total labor compensation for missing years.

Results

Total investment in economic competencies is represented in Table 4. Investment in this category is broadly dominated by investment in firm-specific resources. While the share of firm-specific intangible investments in GDP grew 18%, the share of brand equity intangibles grew 30% from 2003 to 2012. Advertising expenditures corresponds to 90% of investments in brand equity intangibles. Shares of investment in firm-specific intangibles are almost equal for its two subcategories. Only 10% of organizational structure intangibles is purchased.

Table 4: Economic Competencies Investments in Turkey

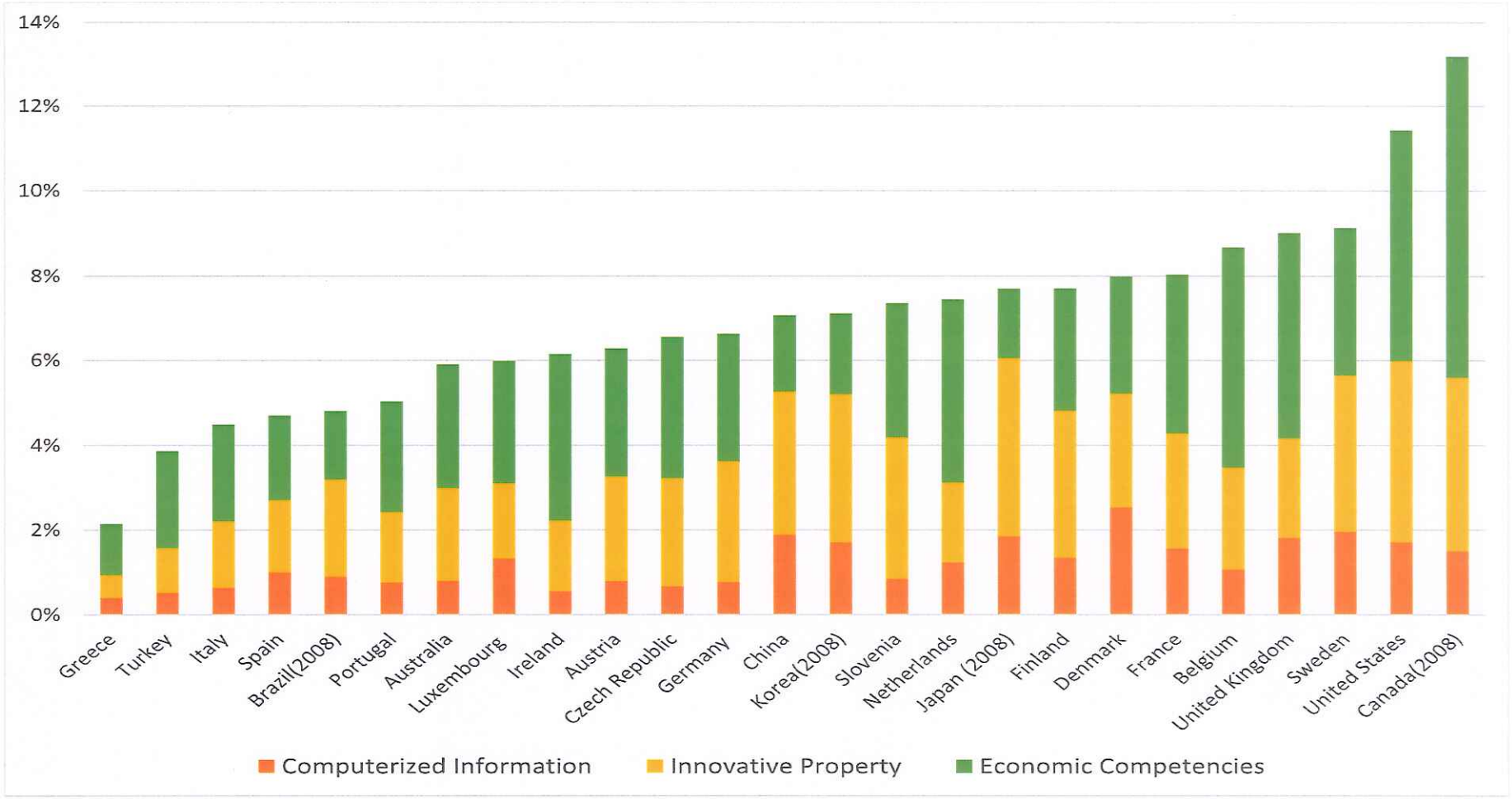
Year	Nominal Investment*	% of GDP
2003	9,192	2.02
2004	12,840	2.20
2005	14,225	2.19
2006	15,032	1.98
2007	17,169	2.04
2008	19,204	2.02
2009	21,010	2.21
2010	25,299	2.30
2011	30,664	2.36
2012	34,613	2.44

*Millions of TL.

2.4 Total Intangible Capital Investments in Turkey

Total investment in intangibles increased from 2.95% to 4.18% of GDP between 2003-2012. Intangible investment was far below of tangible investment in the same period which is measured between 16,9% and 21,8% of GDP. Figure 3 shows cross-country intangible investment comparison. For all types of intangibles, Turkish investment rate is similar to Mediterranean EU countries (Greece, Italy, Spain and Portugal) instead of developing countries like China, India or Czech Republic. In 2010, average intangible investment in Mediterranean EU countries was 4,42% of GDP while the same ratio was 3,87% for Turkey. On the other hand, it must be noted that these countries were suffering a financial turmoil in 2010 and it must have a decreasing affect in their investments.

Figure 3: Business Investment in Intangible Assets as % of GDP (2010)



Source: Based on INTAN-INVEST (www.intan-invest.net), the Japanese Industrial Productivity database, Chun et al. (2012) for Korea, Baldwin et al. (2012) for Canada, Hulten and Hao (2011) for China, Hulten et al (2012) for India, Dutz et al. (2012) for Brazil. Data for Turkey estimated by the author.

3 Growth Accounting with Intangibles

3.1 The Model

CHS (2006) developed a framework where intangible capital can be incorporated into conventional sources-of-growth model. The growth accounting implications of capitalizing intangible expenditures compared with their current treatment as intermediate goods can simply be illustrated by considering a world of three goods: a consumption good C, a tangible investment good I, and an intangible good N.

When the intangible is considered to be an intermediate good, it is an input to the other two goods (C and I), and labor L and tangible capital K are inputs to all three goods. N therefore nets out of the aggregate and does not appear separately in the GDP identity.

If the intangible is treated as capital, the output of the intangible, N, enters in the production functions of the consumption and tangible investment sectors as a cumulative stock rather than as an intermediate input. The intangible capital stock accumulates according to the perpetual inventory method $R_t \equiv N_t + (1 - \delta_R)R_{t-1}$, in the same way as tangible capital. The production functions and factor payment equations are written as follows:

Intangible sector	$N_t = F_N(L_{N_t}, K_{N_t}, R_{N_t}, t)$,	$P_{N_t}N_t \equiv P_{L_t}L_{N_t} + P_{K_t}K_{N_t} + P_{R_t}R_{N_t}$
Tangible sector	$I_t = F_I(L_{I_t}, K_{I_t}, R_{I_t}, t)$,	$P_{I_t}I_t \equiv P_{L_t}L_{I_t} + P_{K_t}K_{I_t} + P_{R_t}R_{I_t}$
Consumption sector	$C_t = F_C(L_{C_t}, K_{C_t}, R_{C_t}, t)$,	$P_{C_t}C_t \equiv P_{L_t}L_{C_t} + P_{K_t}K_{C_t} + P_{R_t}R_{C_t}$

where $L \equiv L_N + L_I + L_C$, $K \equiv K_N + K_I + K_C$ and $N \equiv N_I + N_C$.

The production functions are linked to the accounting identities by the assumption that each input is paid the value of its marginal product. In this case, the GDP identity includes the flow of new intangibles on the expenditure side and the flow of services from the intangible stock on the income side:

$$P_Q Q \equiv P_C C + P_I I + P_N N \equiv P_K K + P_L L + P_R R$$

P_R is the price of renting a unit of the finished knowledge stock (e.g., a license fee for a patent or blueprint). The standard expression for the user cost of any asset was derived

by Jorgenson (1963) and gives the relationship between P_N, the price of a unit of newly produced finished knowledge (an investment or asset price), and its unit rental price:

$$P_R = (r_t + \pi + \delta_R).P_N$$

where r_t is the net rate of return common to all capital in year t (taxes are ignored) and π is the expected capital gain (loss) on intangible capital, i.e., the expected rate of change of P_N. A similar equation is written in terms of tangible capital to complete the model.

The net rate of return r_t is estimated endogenously using the procedure developed in Jorgenson and Griliches (1967) that solves for the common value of r_t in each year that causes the GDP identity to hold for all types of capital, intangible and tangible. Then, the sum of rental prices multiplied by capital stocks (K^j) for each asset class would equal capital income (Y_K):

$$Y_K = \Sigma P_{K_j}.K_j$$

Calculating the endogenous rate of return is simply a case of reorganizing the rental price equation to include capital income and the capital stock.

$$r = \frac{Y_K - \Sigma K_j.(\delta_j + \pi).P_{K_j}}{\Sigma K_j.P_{K_j}}$$

3.2 Model Implications

The conventional SOG framework allocates the output growth to the share-weighted input growth and a residual, multifactor productivity (MFP) growth. Following Solow (1957), the SOG equation is derived by logarithmic differentiation of GDP identity:

$$\dot{Q} = s_C.\dot{C} + s_I.\dot{I} + s_N.\dot{N} = s_K.\dot{K} + s_L.\dot{L} + s_R.\dot{R} + \dot{MFP}$$

where $\dot{x}$ denotes the rate of growth of variable x and income shares are:

$s_K \equiv (P_K K)/(P_K K + P_L L + P_R R)$, $s_L \equiv (P_L L)/(P_K K + P_L L + P_R R)$ and
$s_R \equiv (P_R R)/(P_K K + P_L L + P_R R)$

Rearranging SOG equation gives MFP growth as:

$$\dot{MFP} = \dot{Q} - s_K.\dot{K} - s_L.\dot{L} - s_R.\dot{R}$$

This can also be expressed in labor productivity (LP) terms by rearranging SOG equation, to provide the expression for a decomposition of LP growth.

$\dot{Q} = s_L.\dot{L} + (1 - s_L).\dot{TK} + \dot{MFP}$ where $TK \equiv K + R$ and $s_K + s_L + s_R = 1$

$\dot{Q} - \dot{L} = s_L.\dot{L} + (1 - s_L).\dot{TK} + \dot{MFP} - \dot{L} = (1 - s_L).\dot{L} + (1 - s_L).\dot{TK} + \dot{MFP}$

$(\dot{Q/L}) = (1 - s_L).(\dot{TK/L}) + \dot{MFP}$

That is $\dot{LP} = \dot{KD} + \dot{MFP}$

where capital deepening is $\dot{KD} = (1 - s_L).(\dot{TK/L}) = s_K.(\dot{K/L}) + s_R.(\dot{R/L})$

3.3 Model Implementation for Turkey

In order to estimate intangible-adjusted SOG equation for Turkey, approximations of real intangible investments and capital stocks are necessary. Real investment for each category of intangibles was obtained by deflating the nominal investment estimates by the nonfarm business output deflator. This deflator is viewed as one of the best estimators of intangibles price indexes in the literature as deeply investigated in CHS (2006).

Although there is not any detailed study about depreciation rates for intangible assets, INTAN-INVEST project estimates them based on the evidences stated in CHS (2006) and a survey conducted by Awano et al. (2010) with the UK Office of National Statistics. Their estimations for individual assets are shown in the table 5. These depreciation rates are relatively high, which reflects the assumption that intangible capital has a relatively short productive life.

The data for nominal ICT capital investments is available in the Total Economy Database of The Conference Board and deflated by the sub-index of PPI related to ICT products. As widely used in the literature, the depreciation rate of ICT capital is assumed to be 10%. Depreciation rate for other tangibles is obtained from Penn World Table 8.1.

Given the depreciation rates, initial capital stocks for both tangibles and intangibles are estimated as suggested by Harberger (1978):

$$K_0 = \frac{I_0}{\delta_K + g_I}$$

where I_0 is the level of gross fixed capital formation in the initial period and g_I is the average rate of growth in gross fixed capital formation.

Table 5: Depreciation Rates for Intangible Assets

Asset Type	**Depreciation Rate**
Computerized Information	
1. Software	0.315
2. Databases	0.315
Innovative Property	
3. Mineral Exploration	0.075
4. R&D (Scientific)	0.150
5. Entertainment & Artistic Originals	0.200
6. New Product/Systems in Financial Services	0.200
7. Design and Other New Product/Systems	0.200
Economic Competencies	
8. Brand Equity	
a. Advertising	0.550
b. Market Research	0.550
9. Firm-Specifics Resources	
a. Employer-Provided Training	0.400
b. Organizational Structure	0.400

The labor input is the total hours worked by people engaged and the price element (hourly wages) is simply derived from labor compensation. Assuming the return from education is priced into wages, human capital is calculated as the change of the number of employees weighted by wages for five schooling levels and it appears as the labor composition term at the SOG analysis.

3.4 Results

Intangible investment in Turkey exceeded 20% of tangibles investments in recent years. Output and input effects of capitalizing intangibles are represented in Table 6. When intangible investment is included, Turkish GDP is 4.6% higher. Share of tangible capital in total income is significantly decreased. Income accruing to intangible capital is increased from 4.6% to 6.5% of GDP between 2003-2012.

Table 7 reports results of the SOG analysis. Total labor productivity growth from 2003 to 2012 increases 1.5% when intangibles are capitalized. Yearly average contribution of intangible capital to labor productivity growth is 0.56%. Contribution of capital

Table 6: Value of Output and Inputs in 2012 (Billions of TL)

	Without Intangibles	**With Intangibles**
1. Conventional Output ($P_C C+P_I I$)	1,273	1,273
2. + Intangible Investment ($P_N N$)	0	59
3. = Nominal Output	1,273	1,332
4. Nominal Output	1,273	1,332
5. = Labor Compensation ($P_L L$)	501	501
6. + Income Accruing to Tangibles ($P_K K$)	772	745
7. + Income Accruing to Intangibles ($P_R R$)	0	86
Shares out of Total Income (percent)		
8. Labor Compensation (5)/(4)	39.4	37.6
9. Tangible Capital (6)/(4)	60.6	55.9
10. Intangible Capital (7)/(4)	0.0	6.5

deepening to labor productivity growth becomes higher. On the other hand, contribution of multifactor productivity is now even lower.

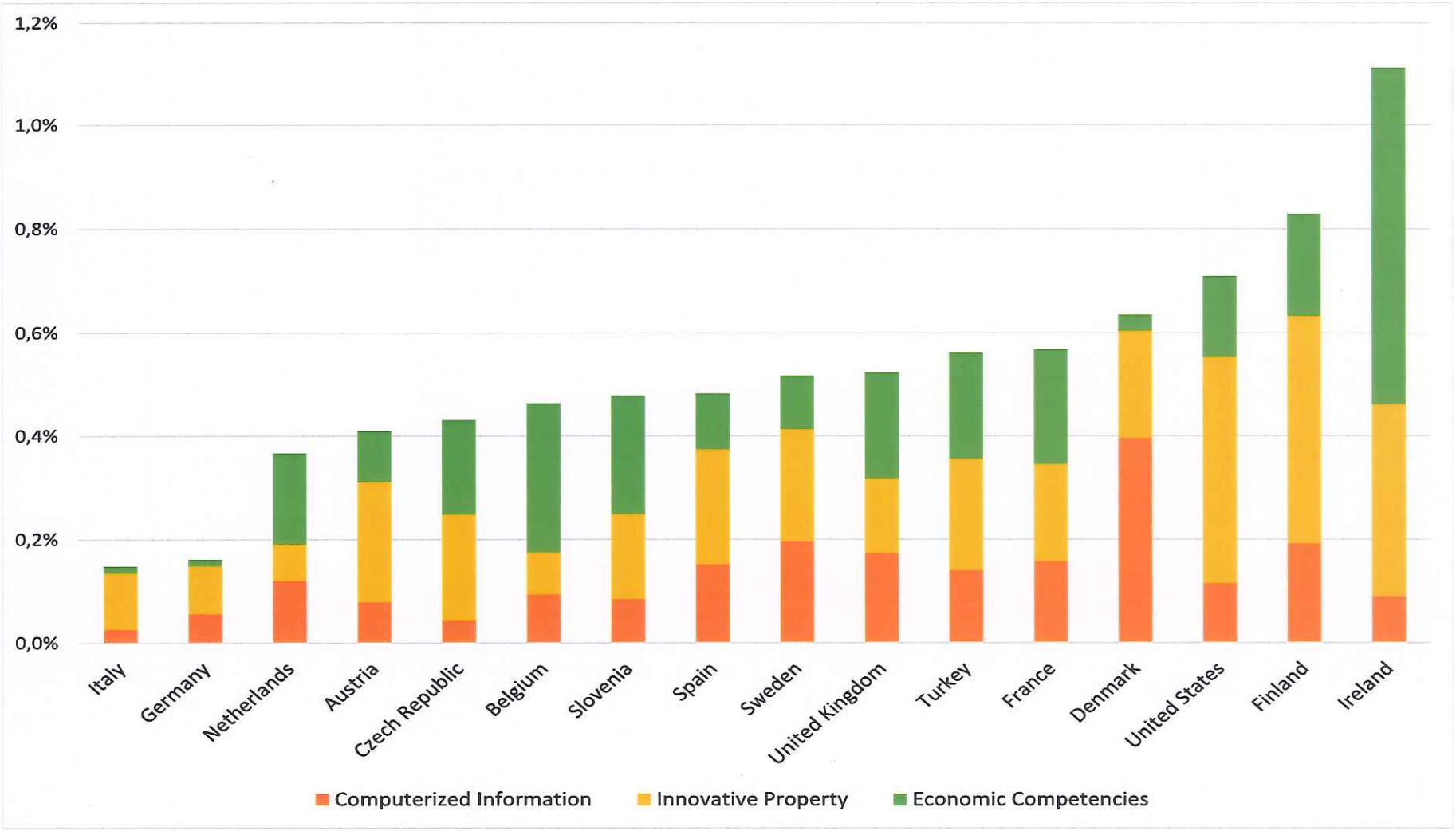
The reason behind the negative multifactor productivity growth of Turkey can be explained by the global financial crisis that have been damaging economies since 2008. The European projects also reported negative MFP growth for some EU countries. Bernanke (1983) found that when workers are costly to hire and fire, high uncertainty gives firms an incentive to delay investment decisions. For most of the years after 2008, business investments in tangibles have decreased drastically in Turkey while labor input have continued to grow. As a result of this capacity utilization fall, multifactor productivity growth was -7.0% in 2008, -8.8% in 2009 and -6.5% in 2012.

Table 7: Annual Average Change (%) in Labor Productivity Between 2003-2012

	Without Intangibles	**With Intangibles**
Labor Productivity	2.79	2.94
Contribution of Components		
1. Capital Deepening	3.84	4.10
1.1 Tangibles	3.84	3.54
1.1.1 ICT Capital (excl. Software)	0.94	0.87
1.1.2 Other Tangibles	2.90	2.68
1.2 Intangibles	-	0.56
1.2.1 Computerized Information	-	0.14
1.2.2 Innovative Property	-	0.21
1.2.3 Economic Competencies	-	0.21
2. Labor Composition	0.45	0.43
3. Multifactor Productivity	-1.50	-1.59

Contribution of intangible capital deepening to labor productivity growth between 2003 and 2010 is illustrated in Figure 4. Investment in intangibles in UK is far beyond of Turkey but its contribution to economic growth is higher in Turkey. That indicates larger marginal product of intangible assets and potential for further economic growth by intangible capital deepening for Turkey.

Figure 4: Contribution of Intangible Assets to Labor Productivity Growth (2003-2010)



Source: Based on INTAN-INVEST (www.intan-invest.net). Data for Turkey estimated by the author.

4 Intangibles and Macroeconomic Policy

4.1 Importance of Intangible Assets for Turkey

It is plausible to expect that firms would decrease their investments in intangible assets in economic downturns but surprisingly intangible investment is more resistant to economic shocks than tangible investment. This implies as the weight of intangibles increases in total investment total economy may become stronger against negative shocks. Table 8 shows changes of both tangible and intangible investment shares in GDP from 2008 to 2009, when the global financial crisis hit economies.

Table 8: Changes in Tangible and Intangible Investment Shares in GDP, 2008-2009

Countries	**Intangible Investment**	**Tangible Investment**
Austria	-1	-7
Belgium	3	-8
Czech Republic	-8	-11
Denmark	5	-18
Finland	2	-5
France	-2	-13
Germany	2	-16
Greece	-6	-14
Ireland	1	-22
Italy	-5	-11
Luxembourg	0	-21
Netherlands	5	-7
Portugal	2	-10
Slovenia	1	-26
Spain	-6	-21
Sweden	-5	-14
Turkey	2	-16
United Kingdom	3	-8
United States	-6	-19

Note: Percentage values.
Source: INTAN-INVEST and author's calculations.

There is a growing literature that warns Turkish economy is stuck in middle income trap (MIT). Kanchoochat and Intarakumnerd (2014) review the MIT literature and group the findings of previous studies about causes of MIT. It is notaable that almost every finding is related to intangible capital. Moreover, these studies reveal that MIT can be overcame by right policies. For example, Felipe et al. (2012) discuss that success story of

Korea depends on Korean government's proactive role that aimed to get competitiveness in complex and highly connected products manufactured by intangible-intensive industries.

In addition to MIT, another structural problem of Turkish economy is its huge current account deficit. Building knowledge intensive high technology production is the leading policy to achieve sustainable high economic growth and a low current account deficit. On the other hand, high technology production can be succeeded by accumulating intangible assets such as software, databases and R&D.

4.2 Drivers of Intangible Investment Growth

Claessens and Laeven (2003) found that preference for tangible assets and a corresponding lower share of intangible assets arise in countries with worse property rights because the returns on tangible assets are easier to secure from the firms' point of view than the returns on intangible assets. A firm is always at risk of not getting returns from its assets (tangible or intangible) due to actions of its own employees or other firms but stealing physical property such as buildings and machinery is more difficult than stealing intangible assets, even when general property rights are not secure. Property rights are very important for securing returns on intangible assets because the value of many intangible assets purely derive from the existence of intellectual property rights.

Financial development is also another important aspect of the intangible investment growth. Financing investments in tangibles is generally easier because such assets are collateralised more favourably by creditors. In case of a default, financier might quickly turn tangible assets to cash since they have a large market and well detailed legislative regulation. On the other hand, creditors don't lean to supply funds for investments in intangibles because such investments are considered riskier.

According to final publication of an OECD project "New Sources of Growth: Knowledge-Based Capital", a market that allocates resources efficiently facilitate intangible investments and innovation. The accumulation and optimal use of intangibles requires experimentation and bankruptcy laws that do not overly penalise failure. OECD studies claim that reducing the stringency of bankruptcy legislation from the highest to the average

level in the OECD could raise capital flows to patenting firms by around 35%. By raising labor adjustment costs, more stringent employment protection legislation also slows the reallocation process. Strict product market regulations such as state control on prices, complex regulatory procedures for licenses and permits systems, tariffs and barriers to international trade might also harm intangible investments. Liberalizing barriers to international trade and investment might stimulate development of intangibles by increasing knowledge diffusion and technology transfer across borders and industries.

High level of education is also another driver of intangible investment as intangible-intensive industries demand for a workforce whose skills can adjust rapidly to new technologies. Current R&D literature suggests plenty of evidences that indicate higher level and quality of education promotes innovative activity.

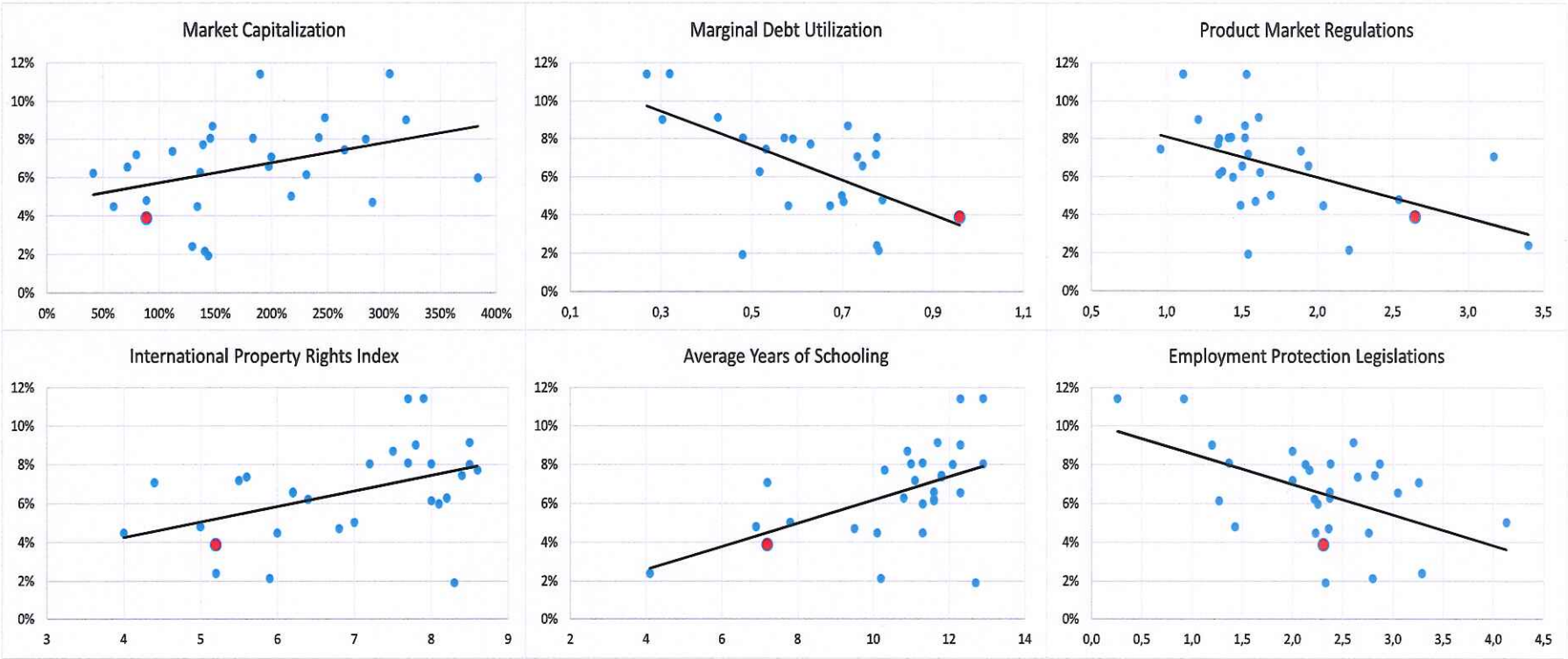
Corporate income tax rates affect investment decisions of multinational companies which generally operate in highly intangible-intensive industries. Devereux et al. (2008) showed that countries compete over corporate tax rates. Attracting such companies may benefit local companies by spill-over effect of their technologies.

Table 9: Correlations Between Investments and Some Economic Indicator

Indicators	**Intangible**	**Tangible**
Market Capitalization	0.38	-0.29
Marginal Debt Utilization	-0.61	0.39
Product Market Regulations	-0.51	0.70
International Property Rights Index	0.45	-0.57
Average Years of Schooling	0.53	-0.46
Employment Protection Legislations	-0.52	0.24

Note: For values and data sources of tangible and intangible investment, please see Figure 1. Market capitalization is a measure of financial development and the ratio of domestic credit plus stock market capitalization to GDP. Data is obtained from World Bank. Marginal debt utilization is another measure of financial development suggested by Boyd and Jalal (2012). Values are turned to positive and the higher the values, the lower the financial development. Product market regulations and employment protection legislation indexes are published by OECD. Schooling data is obtained from a database established by UNDP as a combination of various publications. International property rights index is created by Property Right Alliance and data is available at http://internationalpropertyrightsindex.org

Figure 5: Drivers of Intangible Investment Growth



Note: Larger red points stand for Turkey and vertical axes represent intangible investment as % of GDP. For values and data sources of intangible investment, please see Figure 1. Market capitalization is a measure of financial development and the ratio of domestic credit plus stock market capitalization to GDP. Data is obtained from World Bank. Marginal debt utilization is another measure of financial development suggested by Boyd and Jalal (2012). Values are turned to positive and the higher the values, the lower the financial development. Product market regulations and employment protection legislation indexes are published by OECD. Schooling data is obtained from a database established by UNDP as a combination of various publications. International property rights index is created by Property Right Alliance and data is available at http://internationalpropertyrightsindex.org

4.3 Intangible Investment Incentives of Turkish Firms

Unfortunately, there is not a survey specifically investigated Turkish firms' experience with intangibles. However, Eurobarometer published a survey report "Investing in Intangibles: Economic Assets and Innovation Drivers for Growth" in 2013 which covers firms from EU27 countries, Turkey, Croatia, Macedonia, Russia, Iceland, Norway, Switzerland, Japan, United States. This survey suggests great policy implications for intangible investments in Turkey.

Turkish firms mentioned "rapid development of products and services" and "higher labor productivity" instead of "lower production cost" or "ensuring lower prices" when they are asked about their priorities. Moreover, Turkey is ranked first and third respectively among 36 countries, where firms most mentioned product development and labor productivity. That is a striking result which demonstrates that Turkish firms' main problem in competitive markets is not about prices but innovation. Turkey is also the top country where firms spent most to branding and organizational improvements from "external providers" but also where firms discouraged from intangible investment due to "limited external sources of information or expertise". Such results reveals that Turkish firms are in a great need of intangible capitals yet they face problems about acquiring them.

Turkey is among the top countries where firms most mentioned "public financial support" and "more rapid development of products and services" when asked about their motivations for investment in intangible assets. On the other hand, 64% of Turkish companies reported that "high costs of the investment" discouraged them from investing in intangibles. This is the second highest ratio after Portugal (66%). "Regulatory framework of the industry is difficult to understand" is mentioned by 37% of Turkish companies, which is again the second highest ratio after Portugal (38%). This results are compatible with the relationship of intangible investments with financial development and market regulations that is mentioned in previous section.

The survey also found out that Turkish companies benefit from their investment in intangibles as much as EU27 countries and US. Proportion of Turkish companies which reported their previous investments in intangible assets have at least some (more than

little) benefited their company in terms of: sales is 45% (48% EU27, 48% US), profit margin is 33% (36% EU27, 43% US), skills and qualifications of employees is 54% (53% EU27, 41% US), market share is 49% (37% EU27, 32% US) and overall company value 49% (43% EU27, 45% US).

5 Conclusion

Turkish economy is stuck in middle income trap and has been suffering from persistent current account deficit. Economic literature suggests innovative transformation as a cure for these problems. Recent studies indicate such a transformation can be achieved by investing in intangible assets.

This study revealed that intangible investment in Turkey was 2.95% of GDP in 2003 and increased to 4.18% in 2012. Even though there is a significant rise, intangible investment in Turkey is very low compared to other European countries. When intangibles are capitalized, Turkish GDP go up 59 billion TL or 4% in 2012 and intangible share in total production is 6.5%. Intangible capital deepening contributed 0.56% to annual labor productivity growth, a similar rate with European countries. These findings exhibit the importance of intangibles in promoting economic growth.

There are strong evidences about some possible drivers of intangible investment growth. Financial development is a key factor since financing intangible investment can be challenging. Indicators show Turkish financial industry is not well developed, and Turkish firms report that they often face problems about financing their investments. Low level of property rights protection is another discouragement. Complex and non-competitive market regulations may also harm firms' investment incentives.

Although Turkish firms refer to current public financial supports as a good motivation, they cannot be sufficient alone. Turkey can succeed its transformation to knowledge-based economy by removing barriers on intangible investment. Policy makers should focus on those obstacles and also, further research is needed to reveal factors behind cross-country intangible investment differences.

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